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U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
HENRY W. HENSHAW, *Chief*

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NORTH AMERICAN FAUNA

No. 39

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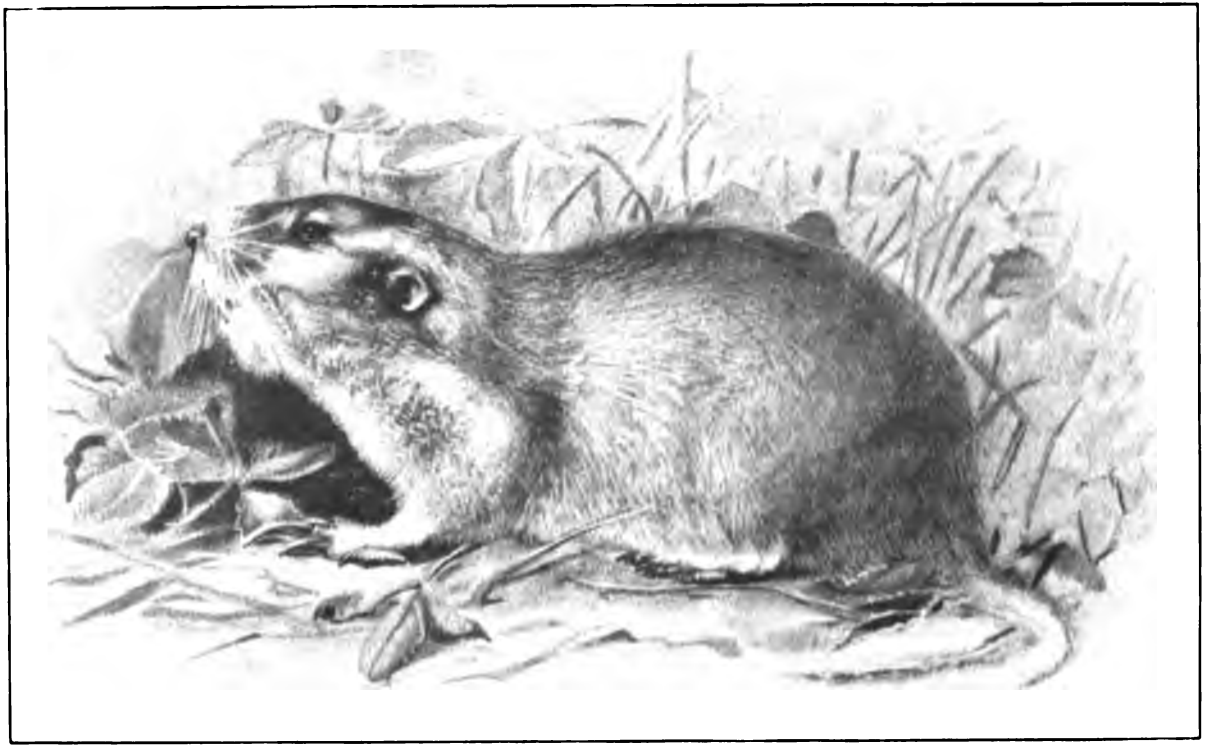
REVISION OF THE POCKET GOPHERS OF THE GENUS THOMOMYS

BY

VERNON BAILEY
CHIEF FIELD NATURALIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1915



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PRAIRIE POCKET GOPHER (THOMOMYS TALPOIDES RUFESCENS.)

About two-thirds natural size. From colored drawing of a specimen from Carberry, Manitoba, by Ernest T. Seton.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
HENRY W. HENSHAW, *Chief*

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LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., April 29, 1915.

Sir: I have the honor to transmit herewith for publication as North American Fauna No. 39, a revision of the pocket gophers of the genus *Thomomys*, by Vernon Bailey, chief field naturalist of the Biological Survey.

Pocket gophers are burrowing rodents which in pursuit of food and in running tunnels often damage crops, young trees, and irrigation ditches. Moreover, the heaps of earth ejected from the tunnels not only cover more vegetation than the animals eat, but also obstruct the operation of mowing machines. Gopher burrows frequently penetrate and cut through irrigation-ditch banks, and the escaping water becomes a menace to agriculture and sometimes to human life. The animals are thus of considerable economic importance.

The present paper completes the technical revision of the pocket gophers (family Geomyidæ), the first part of which was prepared by Dr. C. Hart Merriam and published in 1895 as North American Fauna No. 8. The revision will supply definite information regarding the status and geographic distribution of the several forms, which is important in connection with attempts to control or exterminate them.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. David F. Houston,
Secretary of Agriculture.

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No. 39. NORTH AMERICAN FAUNA. Nov. 15, 1915.

REVISION OF THE POCKET GOPHERS OF THE GENUS THOMOMYS.

By VERNON BAILEY.

INTRODUCTION.

Pocket gophers, a group of rodents peculiar to North and Middle America, belong to the family Geomyidæ, which includes the genera *Thomomys*, *Geomys*, *Pappogeomys*, *Cratogeomys*, *Platygeomys*, *Orthogeomys*, *Heterogeomys*, *Macrogeomys*, and *Zygogeomys*. The present revision deals only with the genus *Thomomys*,[1] which is distinguished from the others by the practically ungrooved surface of the upper incisors. The large fur-lined external cheek-pouches are a family character shared by all genera and species, as are the general habits of living in underground burrows and throwing up heaps of earth along their lines of tunnels. The genus *Thomomys* includes 88 recognizable forms of 40 species. These vary in size from that of a small mole to that of a large rat, and in color from light buff to yellow and gray, and from many shades of brown and rusty to dusky and even black. All are short-legged, robust, sturdy little animals, with small ears and eyes, and short, smooth hair.

Gophers of the genus *Thomomys* are abundant over almost the entire western half of the United States, in a great area of southwestern Canada, and over much of Mexico (see fig. 1), covering considerably more territory than all the other members of the family together. The various forms do not overlap in range to any great extent, but in the area occupied they are present in almost every locality, and are especially abundant in fertile and valuable agricultural lands. Their burrows are a constant menace to agricultural operations, irrigation ditches, and reservoirs. Their food is entirely of vegetable matter, and of this roots, bulbs, and cultivated crops are preferred. In destroying crops and fruit trees they cause a heavy loss to western farmers each year, and it is necessary in farming areas to use every possible means of restraining their increase and checking their depredations. In wild land, on the other hand, their presence is highly beneficial, not only because they stir the soil and enrich it by burying vegetation under their mounds, but also because they form a network of underground channels which aid materially in retaining water and carrying it deeper into the ground. Such of their beneficial habits as have operated for ages in enriching the western soils are far overbalanced in agricultural lands by their destructive habits. On lands newly brought under cultivation it is often necessary to wage an active campaign against gophers, in order to render the crops fairly safe. (See footnote, p. 14.)

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[1] In 1895 Dr. C. Hart Merriam monographed the family Geomyidæ, exclusive of the genus *Thomomys* (N. Am. Fauna No. 8), and also included a chapter on the anatomy and relationships of *Thomomys* and a map of the genus without reference to its specific and subspecific divisions. It was my privilege to assist him in working over the material for his monographic revision and later I was assigned the task of completing the revision of the genus *Thomomys*.

The present paper describes the recognizable species and subspecies and defines their geographic distribution so far as at present known.

GENERAL HABITS.

BURROWS.

Pocket gophers of the genus *Thomomys* are burrowing animals which spend most of their lives underground. The several species have practically the same habits except as modified by environment. They are sturdy little miners, drifting their tunnels on and on in search of food, throwing out little heaps of earth along the lines of excavation, and then quickly closing the doorway. The tunnels vary from about 6 inches to a foot below the surface, and from about 1½ to 3 inches in diameter, according to the size of the gopher. The length of the tunnels is practically interminable and their course varies from a winding network to long direct lines.

The character of the burrows is determined by the food supply. A row of potatoes may be followed across a field, or the spreading roots of an apple tree may hold the attention of the gopher for some time. If food is scarce the rows of mounds reach in direct lines for long distances, but when it is abundant they wind back and forth within a limited area. While the males move about more freely at the beginning of the breeding season and there are indications of rare migrations, pocket gophers are evidently the most restricted in their habitat of any of our native mammals. Even moles, which live more completely underground, burrow more rapidly and travel more widely. The whole summer's line of hills of one gopher can often be seen at a glance. The animals rarely leave an alfalfa or potato field, but hurry across waste places. Under ordinary circumstances, however, a gopher often spends a year on a single acre, and perhaps the next year on an adjoining one. Most gophers probably never get 40 rods from where they were born, but where environment is less favorable and the gopher is more active, he may extend his tunnels for half a mile or possibly a mile during his career.

Little mounds of earth, thrown out as the burrows are excavated, and varying in bulk normally from a quart to a bushel and in distance from a close proximity to 15 feet apart, mark the lines of the burrows. After the loose soil is pushed out, the openings are securely packed with earth and closed from within as a fortification against enemies. The entrances are often closed so securely that even the experienced trapper has difficulty in locating the burrow beneath.

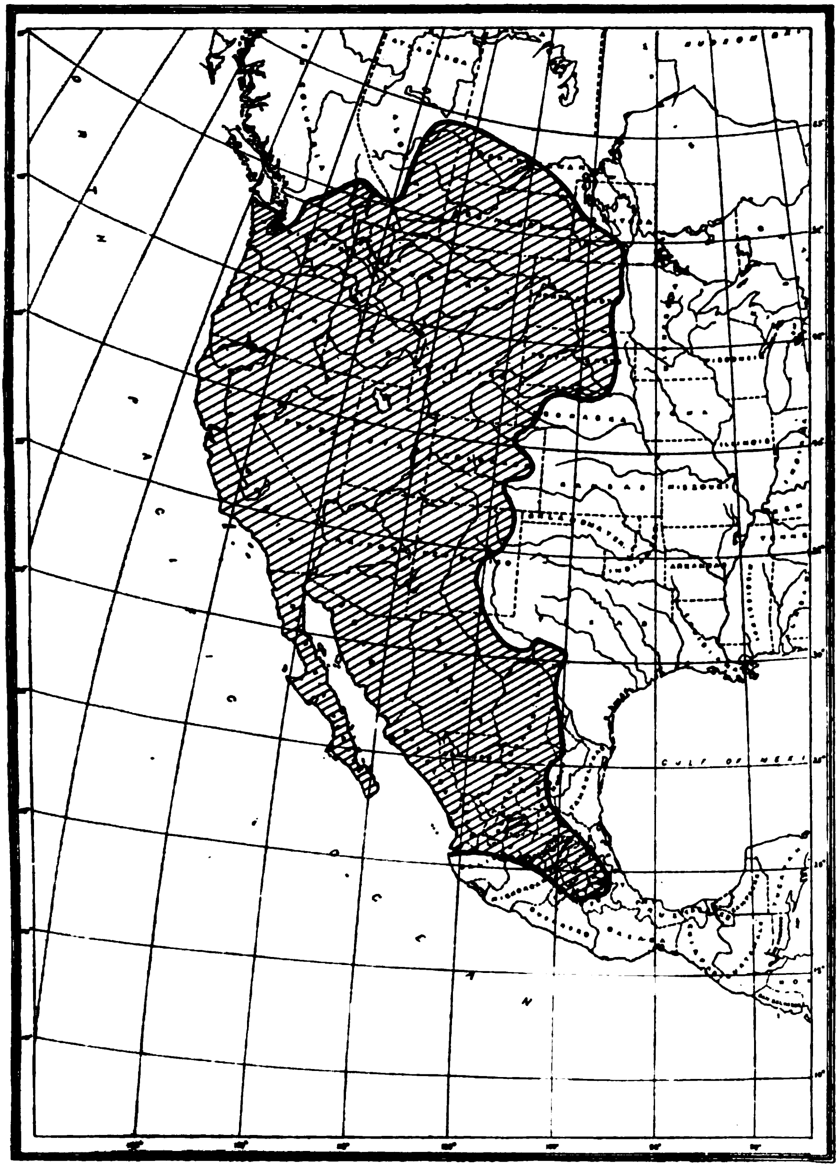

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FIG. 1.—Map showing the distribution of the genus *Thomomys* (shaded area).

Usually, however, the opening may be found by the depression where the last load of earth was left, and the direction of its slope downward determined by the position from which the mound of earth was pushed out. This also serves to distinguish a gopher hill from a molehill, as the mole pushes up the earth from below without making an opening to the daylight. Often the opening is near some plant, as the gopher evidently recognizes a choice species by the root and, following it to the surface, devours or carries it away.

These mounds or "gopher hills," frequently cover low vegetation; on wild land this serves to enrich the soil, but in fields and meadows they often cover and destroy the growing grain and forage, and also interfere with mowing and harvesting.

FOOD HABITS.

Gophers of all species of *Thomomys* are strict vegetarians. Their food consists for the most part of roots, bulbs, tubers, and the most edible and nutritious underground parts of plants, but it includes also much green vegetation from aboveground. As they extend their tunnels gophers find wild onions, liliaceous bulbs, wild potatoes, underground beans, grass tubers, and an endless number of edible roots. These are cut in sections or, if of convenient shape and size, tucked in the pockets whole, and when the pockets are well filled are carried to the dining room to be eaten at leisure or deposited in the storeroom for future use. When gophers are trapped their pockets usually contain articles of food, sometimes so much that they stand out on both sides of the head.

The list of plants found in the pockets is long and varied. Some of the fleshy desert plants, as cactuses, yuccas, agaves, and sotol are entered from below and the juicy centers eaten out. Wild clovers and a great many leguminous plants are favorite foods, while grass stems and blades are eaten to some extent. Very small bushes are sometimes cut down near the burrows and the bark eaten, but trees are rarely injured aboveground.

Gophers apparently do not require water, and it is doubtful if they drink at all. Many desert species thrive for long periods, sometimes a year or more, where they can not get water, but green food and juicy roots evidently supply all the moisture they need.

DAMAGE TO CROPS.

Pocket gophers show a keen appreciation of man's efforts in agriculture and horticulture by resorting to cultivated areas. They revel in potato fields, and one gopher will destroy a long row of the tubers, taking one hill after another from the time they first appear until they are harvested. They quickly attack newly planted areas, and where potatoes are stored in the field they often enter the pits to eat the tubers or carry them away. All kinds of garden vegetables and also most field crops are eagerly eaten, either below or above the surface of the ground. Gophers sometimes burrow up into pumpkins or squashes and eat out the insides without the mischief being detected until the empty shells dry up. They will work all summer in grain fields, cutting and eating the leaves, stems, and grain heads and covering with their hills of earth even more grain than they eat. In alfalfa and clover fields and in grass meadows they destroy both roots and tops and pile their mounds over much of the crop, and in addition, by leaving their mounds full of small stones, they dull and break the knives of mowing machines. Their mischief is perhaps most exasperating in orchards and nurseries, as they often injure or kill choice fruit trees by their underground operations. They are very fond of the roots of apple, pear, and fig trees.

In irrigation areas gophers have an annoying habit of burrowing through the ditch banks and letting the water cut its way out, of filling up the smaller ditches with their mounds, and of interfering generally with the most efficient use of water. It is reported that in the spring of 1915 their burrows caused two reservoir dams on the Little Colorado River, near St. Johns, Ariz., to give way, causing the death of eight persons by drowning, and damage to crops to the extent of half a million dollars.

WINTER HABITS.

Apparently none of the pocket gophers hibernate, and in spring, as the deep snows melt, their old burrow-molds are seen snakelike over the surface of the ground as evidence of winter activity. They work below the frost and instead of throwing out mounds they tunnel under the snow along the surface of the ground, probably gathering some green plants as they go, and then fill these snow tunnels with earth from their burrows. This earth freezes and hardens and often remains all summer as earth casts of gopher burrows in the snow. The long safe winter under protection of the snow has probably done much to conserve the species and facilitate their wide dispersal and abundance in high mountains and northern areas.

BREEDING HABITS.

The little known of the breeding habits of *Thomomys* barely suffices for a few general conclusions. In northern and more elevated portions of the country female gophers usually contain small embryos in June, and early in that month a male and female are occasionally caught in the same burrow. This rarely happens later in summer, and it is evident that only one litter of young is regularly raised in a year. In warmer climates the young are born earlier, and in some regions two litters may be raised. Though I have collected many specimens, I have never seen one younger than the nearly half-grown stage, when they begin to move about, nor have I found specimens of young in any of the museum collections. During July and August many half-grown gophers are caught in traps, but then they are working in the parent burrow or starting new lines for themselves. A little later old and young are in independent burrows.

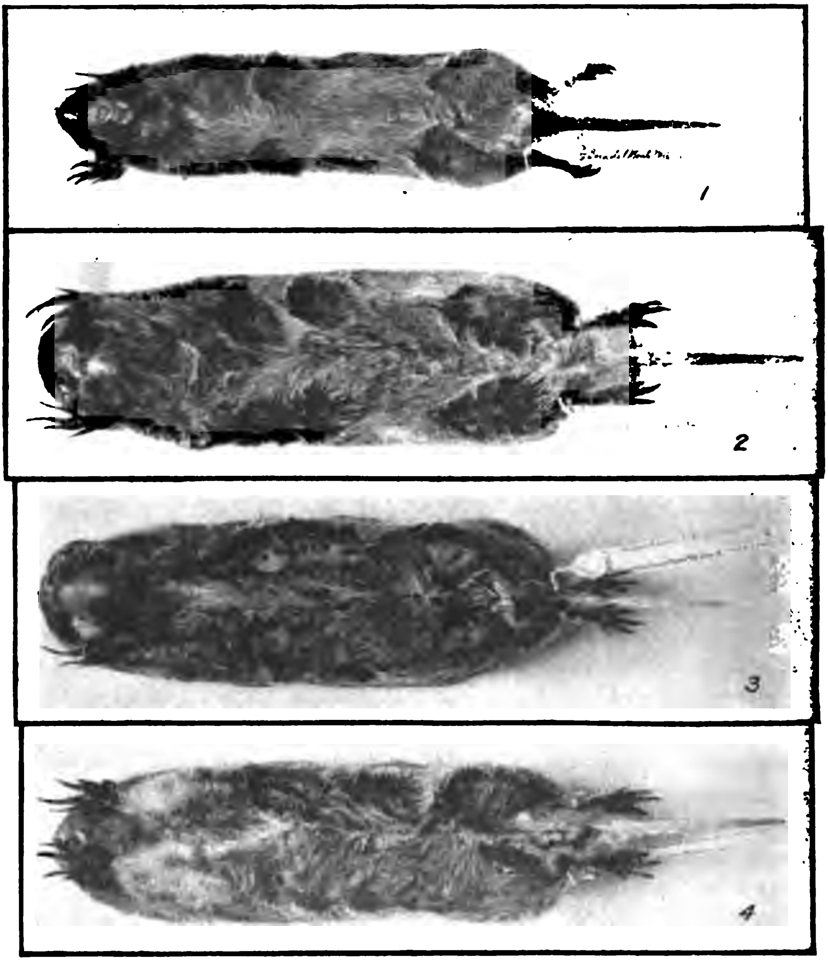

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FIG. 2.—Skins of adult females of *Thomomys*, showing number and position of mammæ in different groups and species. (Exact location of nipple indicated by black dot. Relative position of posterior pairs often distorted by method of sewing up skin.) 1, *Thomomys umbrinus umbrinus;* 2, *T. bottæ bottæ;* 3, *T. fossor;* 4, *T. talpoides rufescens*.

The number of young in a litter varies in the different species, as might be expected from the variation in the number of mammæ in the females (fig. 2). In the *umbrinus* group from Mexico, with 3 pairs of mammæ, the number of embryos has been recorded as 2 and 3. In other species, with 4 pairs of mammæ, the number of embryos has been recorded as 4 and 5, while in the *clusius* and *ocius* groups, with 6 and 7 pairs of mammæ, 6 and 7 embryos seem to be the rule. Judging from nearly matured fetuses the young are born helpless and naked, and must remain for some time in the nest while cared for by the mother. Apparently nothing is known of their nests or breeding quarters.

DISPOSITION.

Like all of the family, gophers of the genus *Thomomys* are pugnacious and fight man or dog as quickly as they would an animal of their own size. To the gopher everything that moves is an enemy and is attacked with vicious wheezing and savage bites. The toe of a boot or a stick is seized, and the heavy incisors make deep cuts into wood or quickly cut through leather. The weasel is probably the gopher's only enemy of its own size that successfully attacks and masters it in its burrows. The gopher's vision is extremely limited, and it seems not to see an object until very close, when its instinct of self-preservation suggests prompt attack.

POCKET GOPHERS AS FOOD.

These gophers are not only strict vegetarians, but are in every way cleanly and exemplary in their food habits. Their flesh is tender and well flavored, and were the animals large enough they might be made a valuable adjunct to our meat supply. They have furnished me with many a palatable meal in the mountains when other food was not available, and would have been of great value to early explorers, who suffered from starvation, had a few gopher traps been carried across the mountains and deserts. Two or three gophers broiled over the coals of the camp fire furnish a fairly substantial and palatable meal, especially if accompanied by a stew of wild onions and bulbs of the camas. Gophers are hardly large enough to be worth catching for the market, however, but where large numbers must be destroyed to protect crops, some may be utilized for the table. The meat is rather dark and fine-grained, tender, and in flavor not unlike that of the squirrel. Sometimes it is rather strongly flavored with wild onions, but to some this is not unpleasant.

NATURAL ENEMIES.

While the underground life of pocket gophers would seem to render them safe from attacks of enemies, yet they are preyed upon by a great variety of animals. Hawks and owls pick up so many of them at their doorways that gopher bones are among the most abundant in the pellets of these birds. Coyotes, foxes, and bobcats pounce upon them as they push out their loads of earth, and badgers occasionally dig them out. Weasels are probably their greatest enemies, and when one gets into a gopher burrow there is no escape for the occupant. Snakes also prey upon them to such an extent that one common species is known as the gopher snake. The protection of such natural enemies of the gopher as prove least harmful in other ways, notably hawks, owls, weasels, and badgers, is of the utmost importance as an adjunct in the control of what is proving in many sections one of the worst of our rodent pests.

DESTRUCTION OF POCKET GOPHERS.

Pocket gophers are easily trapped and poisoned, and on limited areas may be reduced to harmless numbers by systematic, intelligent effort. In extensive fields and meadows and along systems of irrigation ditches or reservoirs their control often presents problems of considerable magnitude. The Biological Survey has made special study of the many conditions under which injuries from gophers occur and of the most economical and efficient means of their control. The results have appeared in several publications of the United States Department of Agriculture.[1]

GENERAL CHARACTERS.

The short legs, strong frame, and powerful muscles of pocket gophers peculiarly fit them for subterranean life. The long front claws vary considerably in size with the different species, being largest in *T. talpoides* and *T. rufescens*, which are medium-sized species, and relatively smallest in *T. bulbivorus*, the largest of the genus; but in all they are well adapted to rapid digging. The stout hind feet, with wholly naked, plantigrade soles and stout nails are well adapted to pushing, while the delicate naked soles of all the feet are doubtless of great advantage as a substitute for eyes in an animal which spends most of its life in utter darkness. Fringes of stiff bristles bordering the fingers and palms evidently assist in holding together the loose earth as it is pushed out of the burrow. The very small eyes and ears are keen at close range, but are of little use in the burrow where most of the animal's life is spent. The stubby and seemingly rather useless tail is slightly tapering, thinly haired, and often naked near the tip. It probably serves as a substitute for eyes in the animal's rapid backward progress through its burrow, as has been shown by Dr. Merriam to be the case with the very similar and closely related genus *Geomys*.[1] The vibrissæ are of just sufficient length to span the diameter of the burrow and doubtless serve as a further substitute for eyes.

---

[1] Pocket Gophers of the United States, by Vernon Bailey. Bul. No. 5, Division Ornithology and Mammalogy, 1895.

Directions for Destroying Pocket Gophers, by David E. Lantz. Circular No. 52, Biological Survey, 1908.

Harmful and Beneficial Mammals of the Arid Interior, by Vernon Bailey. Farmers' Bulletin 335, 1908.

Pocket Gophers as Enemies of Trees, by David E. Lantz. Yearbook Separate No. 506, 1909.

The general pelage is fine and silky, becoming long, full, and soft in winter in cold climates and again becoming thin and harsh in summer. In the southern tropical or subtropical species the fur, if it may be called fur, seems not to attain the full soft winter coat. The pelage consists of a fine all-plumbeous underfur through which rises a longer, coarser coat with plumbeous base and colored tips which give the dominant shade characterizing the species. This usually varies considerably with the season, in some species becoming much darker in winter, in others much paler. The covering on the underparts is usually much thinner, often allowing the skin to show through. The tail, ears, and tops of feet are but thinly clothed with short, stiff hairs. The small nose-pad is naked.

The construction of the mouth is such that both upper and lower incisors protrude from fur-incased mandibles, allowing perfect freedom for cutting roots, digging in hard earth, or prying out stones without danger of the earth entering the real mouth, which opens vertically well back of the incisors and closes automatically as the incisors are spread wide apart. The fur-bordered lips close in a vertical slit in front of the real mouth or draw back and expose an ample cavity and a thick, fleshy tongue.

The pockets, which give the animal unusual interest, have been the cause of much speculation and misapprehension. Some of the specimens first seen by naturalists were stuffed with the pockets wrong side out, Say's genus *Pseudostoma* being based on such a specimen, while Kuhl's *Saccophorus* was based on a specimen showing the pockets in their real position. The use of the pockets is still often misunderstood. They are external invaginated folds of skin, fur lined, and opening along each cheek parallel with the mouth and extending approximately 1½ to 2 inches back under the skin of the shoulder. They are very elastic and when empty might pass unnoticed, but when filled they more than double the apparent size of the animal's head. I have often thrust two fingers half their length into the two pockets of a small-sized gopher, reaching back almost to the middle of the animal's body. In large species the thumb fits nicely in the empty pocket. In removing a gopher's skin a thin band of muscle is discovered attached to the apex of each pocket and by it they are drawn back and kept in place. The pockets can not be fully everted without greatly stretching or possibly breaking this muscular attachment, but they can be drawn out so that a large fold of the lining will hang out of the pocket when the animal's muscles are relaxed. It is a common belief that the pockets are used in carrying earth from the burrows, but such is not the case as, in preparing many hundreds of specimens, I have never found earth in the pockets, except for minute particles from roots and bulbs. Other naturalists have given the same negative evidence. On the other hand, the pockets are commonly stuffed full of vegetation. I have often watched the gopher come to the surface, opening a new doorway as he came, and begin to draw down one plant after another, cutting and tucking away the sections in his pockets as he drew them down. His motions are quick as a flash, and that the hands are used in filling the pockets is about all one can be sure of. Dr. Merriam found by watching a captive specimen of *Geomys* that the hands were used for both filling and emptying the pockets.[1]

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[1] N. Am. Fauna No. 8, 16, 1895.

CRANIAL CHARACTERS.

In Dr. Merriam's very full discussion of the morphology of the skull in his Monographic Revision of the *Geomyidæ*[2] numerous figures and illustrations of the genus *Thomomys* are included. In the present work it is therefore necessary only to mention some of the variations and general characters useful in the separation of the various forms.

In all, the cranium is wide and low, with spreading zygomatic arches for the accommodation of powerful muscles. The mandibles are heavy and irregular, and the incisors above and below are long, curved, deeply embedded tools of labor and weapons of defense. The relative length and breadth of the skull vary greatly in different species: shortening of the total length generally implies a relatively wider skull; elongation a relatively narrower. In some species, however, the rostrum alone is elongated or shortened, in others the braincase varies in length and breadth. The generally wedge-shaped nasals are extremely variable in length and form, especially in form of termination at posterior tips. The premaxillæ in some terminate even with the posterior line of the nasals, in others they extend well back into the frontals with pointed, beveled, or truncate tips.

The interparietal furnishes a convenient character for the recognition of many forms, varying from a minute oval to a large quadrate bone covering nearly half the basal width of the skull. In some species, however, it is obscured in old age until completely obliterated in a high sagittal crest, in others advanced age produces no appreciable change. The various forms of the line of junction between the base of the zygomatic processes of the maxillæ and the premaxillæ and frontal and lachrymal bones furnish excellent specific as well as group characters. In the *umbrinus* group the bases of these bones are forked or concave; in most others convex, straight, or doubly curved. There are often good characters in the symphysis of the zygomatic process of the maxilla and the jugal, but this changes considerably with age and is not much used in diagnoses. The pterygoids have a wide range of variation and furnish excellent characters in many species. The large and concave pterygoids of *T. bulbivorus* have been used as the main basis for a subgenus (*Megascapheus*),[1] but while unique they certainly do not carry more than specific distinction. The general variation is in elevation or depression of the wings of the pterygoids, wide or narrow, and sharply V-shaped or widely U-shaped fossa. The audital bullæ vary greatly in relative size and form, the largest being smoothly rounded and globose, the smaller more elongated and angular. The basioccipital varies greatly in relative length and width, generally becoming narrower as the bullæ increase in size and crowd upon its margins. Many slight detailed differences can also be used to advantage as characters. Many excellent characters in the lower mandibles are not generally used in diagnoses, as in most forms there are others more convenient.

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[1] N. Am. Fauna No. 8, 18, 1895.

[2] Ibid., 33 and 198, 1895.

DENTITION.

The dental armature of *Thomomys* is included and fully discussed with the other genera in Dr. Merriam's revision of the Geomyidæ.[2] Throughout the genus *Thomomys* there is surprising uniformity of tooth form and enamel pattern in the molariform teeth; while many minute variations furnish distinctive specific characters, the necessity of studying them with a lens renders them inconvenient for general use, and they rarely serve to separate closely related forms. On the contrary, the incisors furnish conspicuous group as well as specific characters. The angle of the upper incisors to the axis of the skull varies from the very protruding incisors of *T. bulbivorus*, *T. leucodon*, and *T. umbrinus* to the abruptly incurved incisors of *T. pygmæus*, *T. idahoensis*, and *T. ocius*. A narrow groove near the inner edge of each upper incisor is deepest and most conspicuous in the *monticola* group, but so slight and obscure in other groups as to be detected only by critical examination with a lens; it is usually most obscure in species with projecting upper incisors. In some species the incisors are rather slender, and in others relatively stout.

SEXUAL VARIATION.

The male in most species is considerably larger than the female and its skull is heavier, more angular, and more heavily ridged in old age. This sexual difference is greatest in the *bottæ* group and apparently least in the *monticola* and *fuscus* groups, but is noticeable in all.

The functional mammæ vary in fully adult females of different species from 3 to 7 pairs, usually arranged in 2 pairs of inguinal, 2 or none of abdominal, and 1, 2, or 3 of pectoral. The usual number of embryos ranges from 3 to 7.

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[1] Elliot, Field Columb. Mus., zool. ser. III, 190, 1903. Type, *Diplostoma bulbivorum* Richardson.
[2] N. Am. Fauna No. 8, 69–108, 1895.

MOLT.

In the genus *Thomomys* there seem to be normally two complete changes of pelage during the year, from the winter to the summer coat during spring or early summer, and from the summer to the winter coat in fall. The time of these changes varies in different species and often in the same species with different climatic conditions, and apparently also with the varying physical condition of individuals, as age and bodily vigor. In the northern and more elevated areas the molt is more pronounced and its progress more rapid, owing to greater extremes of climate; while in the equable climate of the west-coast areas and in the Tropics of western Mexico very gradual and slight change of pelage occurs. The progress of the molt is normally from the nose over the head and body to the base of the tail along a crescentic line, a little faster on the back than on the sides. On the belly the molt lags behind and is less regular.

The spring molt is most conspicuous, as each succeeding wave of hair is shorter than that displaced and leaves a dark line of plumbeous basal color exposed on the old hair. The change is a creeping process. New hair displaces old on the nose, apparently pushing out the old and worn and taking its place along the line of advance backward and downward. The line is normally a semicircle, but it often becomes distorted by one part progressing more rapidly than another. In some cases the change is complete as it progresses, all the old hair being replaced, but in others the molt is only partial, a thinning or filling-up process, but always progressing along the line in the same way. In spring the first molt wave and often those up to the fifth are but slight changes, a thinning like the removal of one winter shirt after another, but the final, perhaps fifth or sixth, change to the thinnest summer clothing is a complete change as it progresses. The number of molt waves is not easily determined from specimens, as they often overtake and run into each other. The long winter coat is retained on the rump often until late summer, and the successive molt waves strike against this until the short summer coat pushes it off at the base of the tail just before, or sometimes, in high or northern localities, not until, the next winter coat has begun to make its appearance on the nose. There are at least five waves in the spring molt, as this number appears on many specimens taken in May or June. Those taken later in summer usually show a less number of coats but with more deeply marked division lines due to the combination of several waves into one or more.

The fall molt is different. The winter coat is put on more rapidly with the appearance of really cold weather, and apparently the full change is accomplished in two molt waves that begin at the nose and progress over the animal along a semicircular line. The line is not so conspicuous, however, as the longer hair overlaps the short summer coat which it is crowding out, and does not exhibit the plumbeous color along its margin. Often before the first coat has reached the base of the tail the second has begun on the nose and is following the first (fig. 3). This seems not to replace the first but to fill up and thicken the coat, while both may increase in length as the weather becomes more severe.

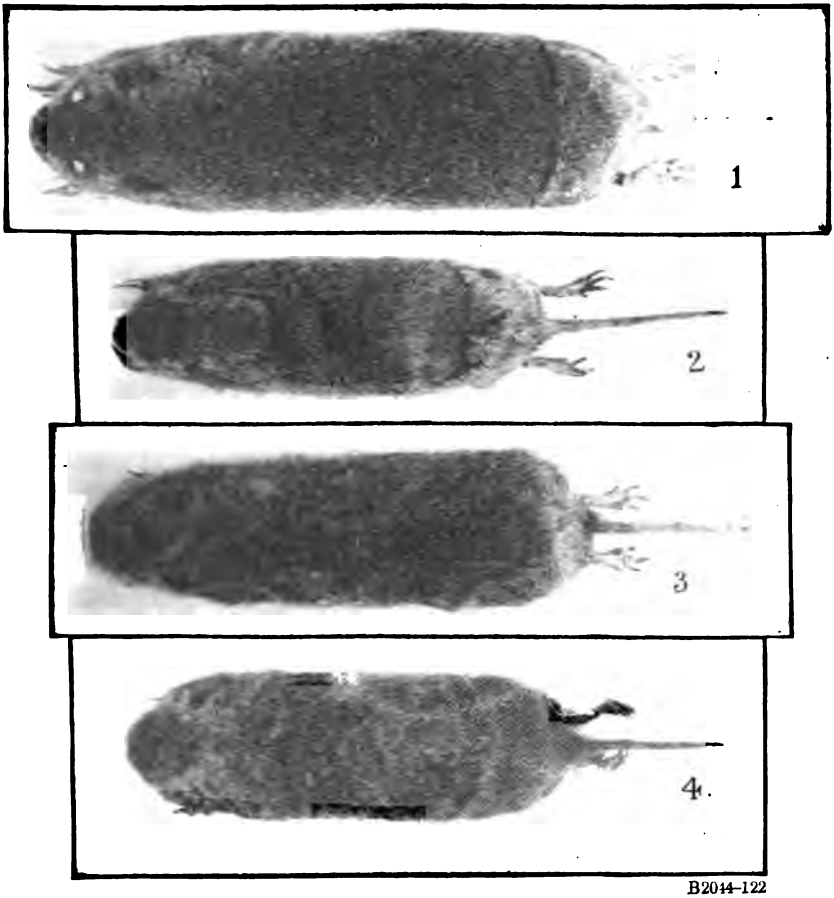

Fig. 3.—Skins of *Thomomys* (U. S. Nat. Mus. specimens) showing waves of pelage during molt.

1. *Thomomys talpoides rufescens*, male adult, No. 180486, Valley City, N. Dak., May 17, 1912, showing five waves of pelage during spring molt.
2. *Thomomys quadratus fisheri*, male adult, No. 94411, Ruby Valley, Nev., June 23, 1898, showing four waves of pelage during spring molt.
3. *Thomomys talpoides clusius*, female adult, No. 160396, Shirley Mountains, Wyo. (8,800 feet altitude) Aug. 21, 1909, showing three waves of spring molt, with coat of previous winter on rump and two waves of fall molt coming in on head: two winter coats at one time.
4. *Thomomys quadratus fisheri*, male adult, No. 80721, Cottonwood Range, Nev., Sept. 17, 1896, showing first wave of fall molt back to rump, second wave back to ears.

Climatic conditions control the time and nature of molt, but not its general plan. Species from high in the mountains and from well north wear heavy winter coats for a longer time: *T. talpoides* from October to April; *T. fossor* and *T. fuscus* from October to May; while those from low hot valleys—*T. perpallidus*, *T. albatus*, and *T. chrysonotus*—wear thinner winter coats from about the first of December to the first of March. Species from the California coast show the usual molts, but with slight contrast between summer and winter, and with considerable individual variation in dates of change. The one fully tropical species, *T. atrovarius*, from western Mexico, is represented by specimens taken from April 5 to August 3, in most of which one molt line appears across the back, and none shows more than one, while there are several without any trace of molt. This condition is rarely found in any other species in summer pelage and is probably due to the tropical climate. Specimens showing a molt line seem to be changing from one thin, harsh pelage to another exactly like it, and whether there is any change to a winter pelage in this species remains to be shown by winter specimens.

When the young, which are evidently born naked, are old enough to begin moving about, they have a fine, short coat of silky hair, which a little later becomes longer and more lax as well as finer and softer than in adults, and when they are about half grown the molt begins on the nose and progresses slowly as in adults, with but one molt to adult summer pelage. This change is not completed until the animal is almost grown, and while it resembles the faded and old worn pelage of adults, it can be recognized by its finer, softer texture.

The number and sequence of molt waves can be satisfactorily determined only by a study of living animals as a supplement to the large series of specimens available.

ABNORMAL PELAGE CONDITIONS.

ALBINISM.

Albinism is rare in the genus *Thomomys*, but a number of specimens examined are fully albinistic and others partially so. One albino of *T. bottæ* from San Francisco is in the U. S. National Museum collection, and Townsend speaks of a "perfect albino" presented to him at San Diego.[1] Two specimens of *T. fuscus* in the Biological Survey collection from Shuswap, British Columbia, are pure white all over. A pure white specimen lacking all of the skull except the front teeth was given me at Scottsburg, Oreg., but the species was not identifiable; it was probably *T. niger*, a species otherwise known only from pure black specimens. Specimens of *T. awahnee* from the Yosemite, *T. mewa* from Fresno Flat, Cal., and *T. pascalis* from Fresno, Cal., show large white patches on backs, arms, and breasts, and one of *T. yelmensis* from Tenino, Wash., shows white patches on one side. The white patches below, on chin, breast, or belly, are often constant and furnish good specific or subspecific characters. Two specimens of *T. aureus* from Shiprock, N. Mex., are light gray all over from a predominance of white or light gray hairs. One of *T. nevadensis* from Battle Mountain, Nev., is hoary over the head and back from a generous sprinkling of white hairs. A specimen of *T. fossor* from the Cochetopa Forest, Colo., is also gray over the head and back in the same manner, but this may belong to another series of abnormal color variation, caused by ticks or skin disease (fig. 4).

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[1] Proc. U. S. Nat. Mus. X, 177, 1887.

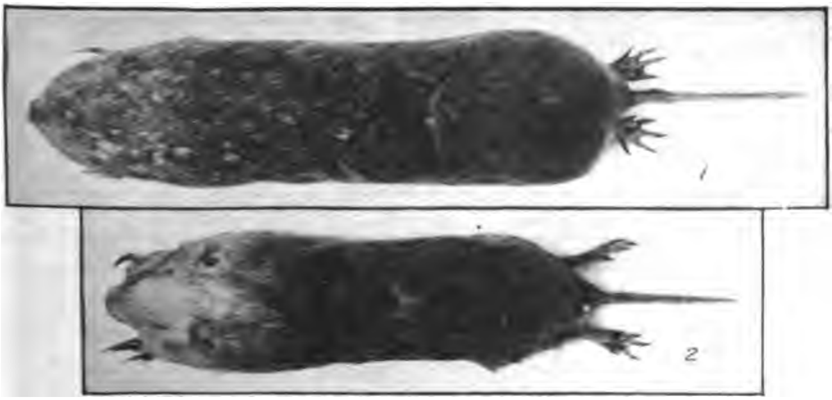

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Fig. 4.—Skins of *Thomomys* (U. S. Nat. Mus. specimens), showing abnormal pelage conditions.

1. *Thomomys fossor*, No. 137661, female adult, Arapahoe Pass, Colo., July 5, 1905. The abnormal white specking is probably due to tick bites.
2. *Thomomys fuscus fuscus*, No. 72949, female adult, Tobacco Plains, Mont., July 8, 1895. The white on head may be due to ticks, mange, or skin disease.

MELANISM.

Melanism is much more common than albinism, as one species, *T. niger*, is known only from pure black individuals, and six other species are more or less melanistic. In *T. townsendi*, from southern Idaho, there are 5 black specimens and 12 of the normal gray. The Biological Survey series contains 36 normal yellow-gray, 18 black, and 10 dark gray individuals. In *T. orizabæ*, of southern Mexico, 14 out of 16 specimens from the type locality on Mount Orizaba are black. Of 8 specimens of *T. umbrinus* from Boca del Monte 4 are almost black and 4 are dark brown. In a series of 11 specimens of *T. atrovarius*, 3 are almost black. One specimen of *T. peregrinus* is fully melanistic, but dichromatism may be rare in the species, as specimens from many other localities are normal. In a large series of specimens of *T. alticolus* from southern Lower California 4 are so dark as to be considered partially melanistic. There are two black skins of *T. talpoides* from Red Deer, Alberta; one of *T. rufescens* from Fish Lake, in the Turtle Mountains, N. Dak.; one of *T. fulvus* from Trumbull Mountains, Ariz.; one of *T. toltecus* from Fairbanks, Ariz.; and several specimens of *T. bottæ* from widely separated localities in California. This is by no means an exhaustive list of melanistic specimens, but merely serves to show how common and widely represented is this variant phase.

Abnormal marking of another type is undoubtedly caused by tick bites. In many specimens of *T. fossor* from the mountains of Colorado, Wyoming, and New Mexico small white specks occur scattered irregularly over the top of head and shoulders, giving the animal a speckled appearance similar to that of tick-bitten Texas horses. The fact that these occur only on the parts of the gophers' bodies not to be reached by their teeth strongly suggests as their origin the presence of small ticks which engorge and remain attached to the skin long enough to produce sores, which when healed are covered with white instead of normal hair. Gophers with speckled heads are represented from Colorado by specimens from 3 and 7 miles east of Cochetopa Pass, from Hahns Peak, Rabbit Ear Mountains, Elk Head Mountains, Longs Peak, Estes Park, Baxter Pass, and Pearl; from Wyoming, by a specimen from Bridger Peak; from Utah, by specimens from the Beaver Mountains; and from New Mexico, by specimens from Costilla Pass, Costilla River (near source), Red River (near source), Taos Mountains, and Twining.

A somewhat similar abnormal condition is found in a few specimens of *T. fuscus* from northwestern Montana. The top of the head and shoulders becomes gray from a considerable mixture of white hairs. The hair has a thin and unnatural appearance, the result, it has been suggested, of mange or a similar skin disease.

VARIATION AND DISTRIBUTION.

The great variety of slight characters and lack of more trenchant characters over a wide range, the abundance and almost continuous dispersal of the genus in this range, and the evident uniform vigor of the whole group indicate that the genus is at the height of its development. It has pushed out from the other perhaps older, more widely differentiated genera of the Geomyidæ and covered more territory and produced more species and subspecies than all the rest of the family. In 1895 Dr. Merriam recognized in the Geomyidæ, exclusive of *Thomomys*, 8 genera embracing 37 species. The genus *Thomomys*, without even a valid subgenus,[1] contains at least 88 recognizable forms of 40 species, and occupies about twice the area of the rest of the family. (See figs. 5 to 10.)

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[1] See first footnote, p. 17.

Thomomys shows its vigor and adaptability by occupying the territory not inhabited by other more robust members of the family, which hold the milder, more luxuriant valleys. It lives in almost every desert valley and rugged desert range of mountains, as well as on the

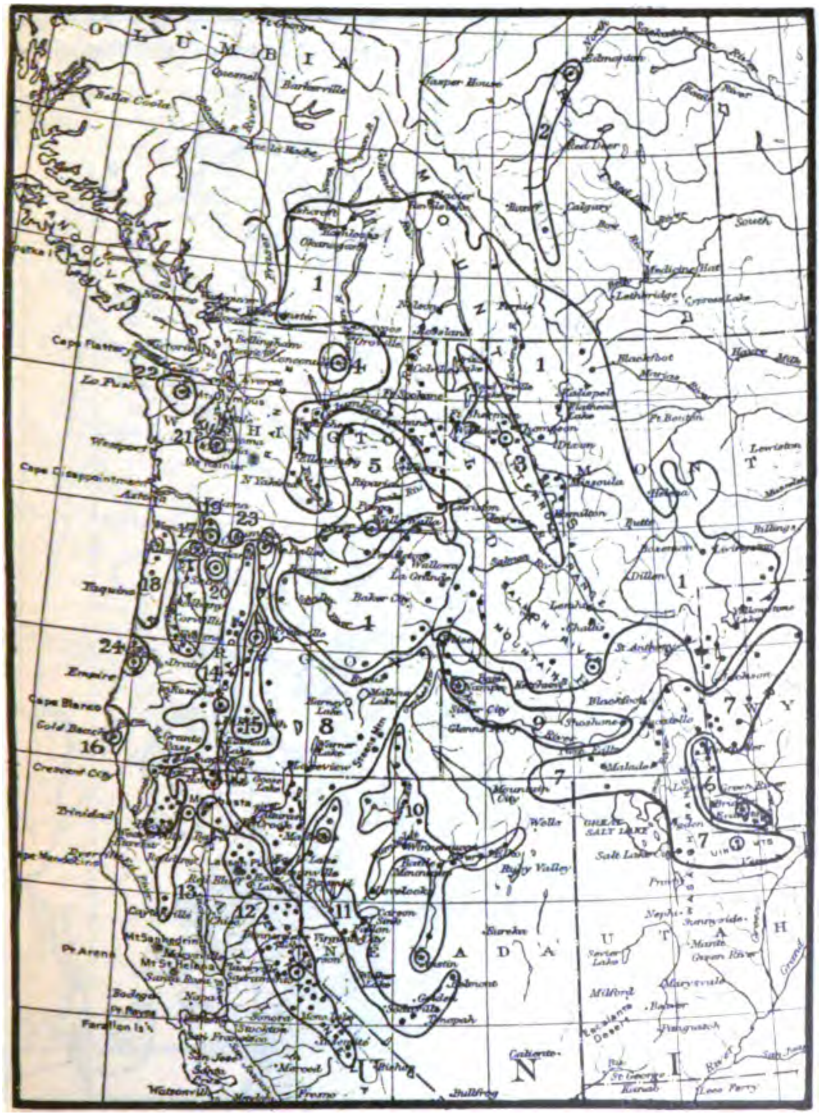

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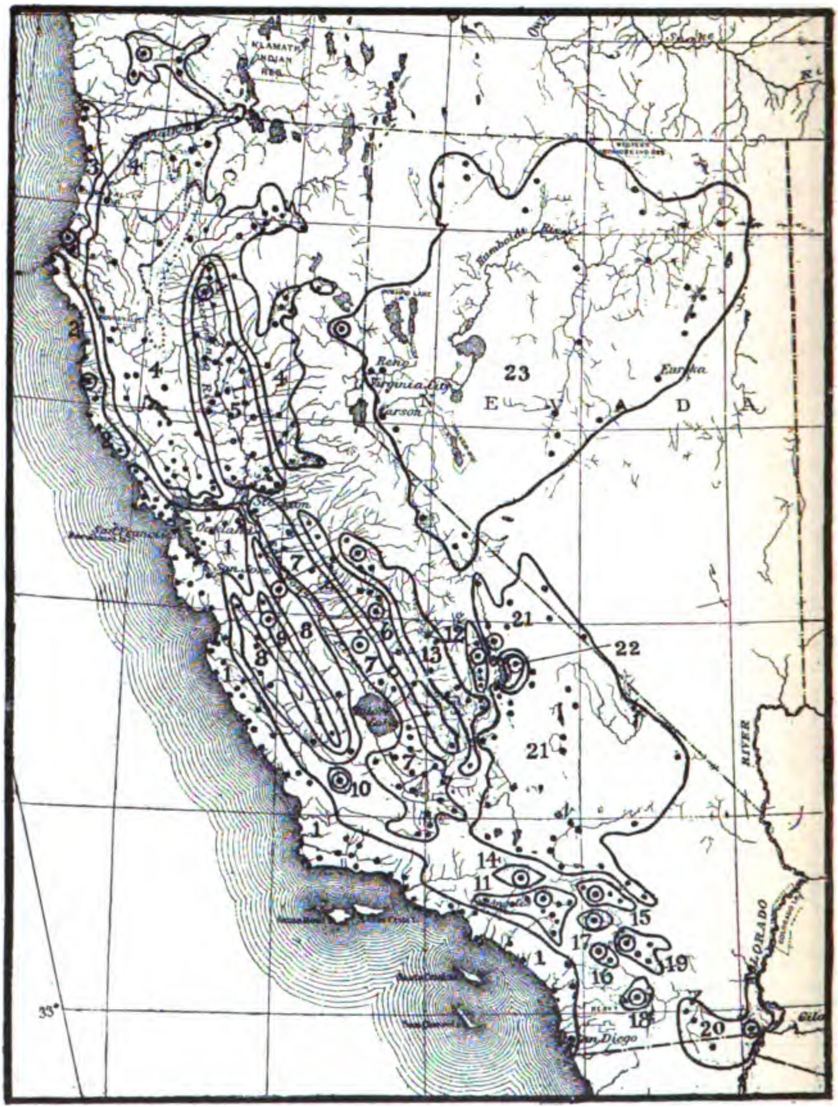
FIG. 5.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

1. *fuscus.*
2. *loringi.*
3. *saturatus.*
4. *myops.*
5. *columbianus.*
6. *bridgeri.*
7. *uinta.*
8. *quadratus.*
9. *townsendi.*
10. *nevadensis.*
11. *canus.*
12. *monticola.*
13. *pinetorum.*
14. *mazama.*
15. *nasicus.*
16. *helleri.*
17. *bulbivorus.*
18. *hesperus.*
19. *douglasi.*
20. *oregonensis.*
21. *yelmensis*
22. *melanops*
23. *limosus.*
24. *niger.*

semiarid plains and stony slopes of the great mountain ranges, and even up through the mountain forests to timber line and often far above on the peaks and crests of high ranges. That these gophers however, prefer comfortable conditions and thrive on mellow



B2047-122

FIG. 6.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

1. *bottæ*.
2. *minor*.
3. *laticeps*.
4. *leucodon*.
5. *navus*.
6. *mewa*.
7. *pascalis*.
8. *angularis*.
9. *diaboli*.
10. *infrapallidus*.
11. *pallescens*.
12. *alpinus*.
13. *awahnee*.
14. *neglectus*.
15. *altivallis*.
16. *jacinteus*.
17. *cabezonæ*.
18. *puertæ*.
19. *perpallidus*.
20. *albatus*.
21. *perpes*.
22. *operarius*.
23. *fisheri*.

soil and an abundant food supply is shown by the development of more robust species under such favorable environment. All the larger species inhabit rich valley bottoms. The smaller are mainly from deserts where food is scarce and conditions for underground life hard and unfavorable.

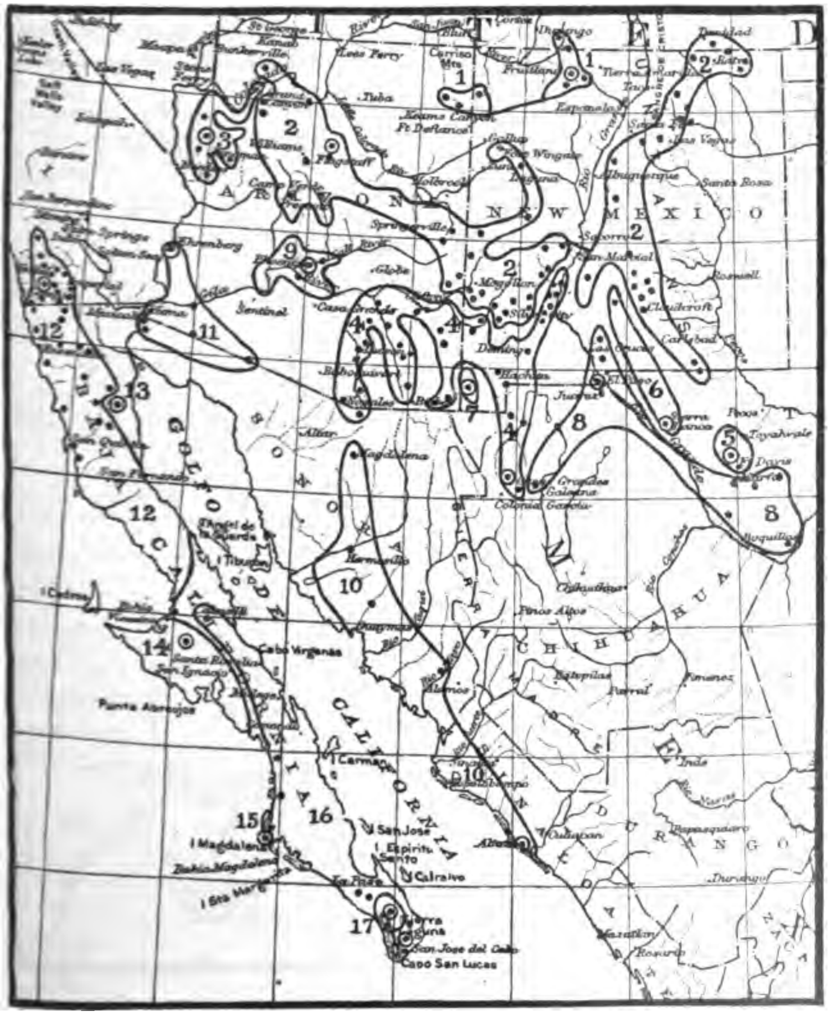


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FIG. 7.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

1. ***apache.***
2. ***fulvus.***
3. ***desertorum.***
4. ***toltecus.***
5. ***texensis.***
6. ***baileyi.***
7. ***mearnsi.***
8. ***lachuguilla.***
9. ***cervinus.***
10. ***sinaloæ.***
11. *chrysonotus.*
12. ***nigricans.***
13. *martirensis.*
14. *russeolus.*
15. *magdalenæ.*
16. *anitæ.*
17. *alticolus.*

For unknown reasons there is practically no overlapping in range of either genera or species in the family. This may be due to the ferocious dispositions of all members of the family. For about 2,000 miles the ranges of *Geomys* and *Thomomys* meet across the Middle West from Pembina, N. Dak., to the lower Rio Grande, apparently without actual overlapping. The same conditions occur along the ranges of large and small species of *Thomomys*, as at Fort Bridger,

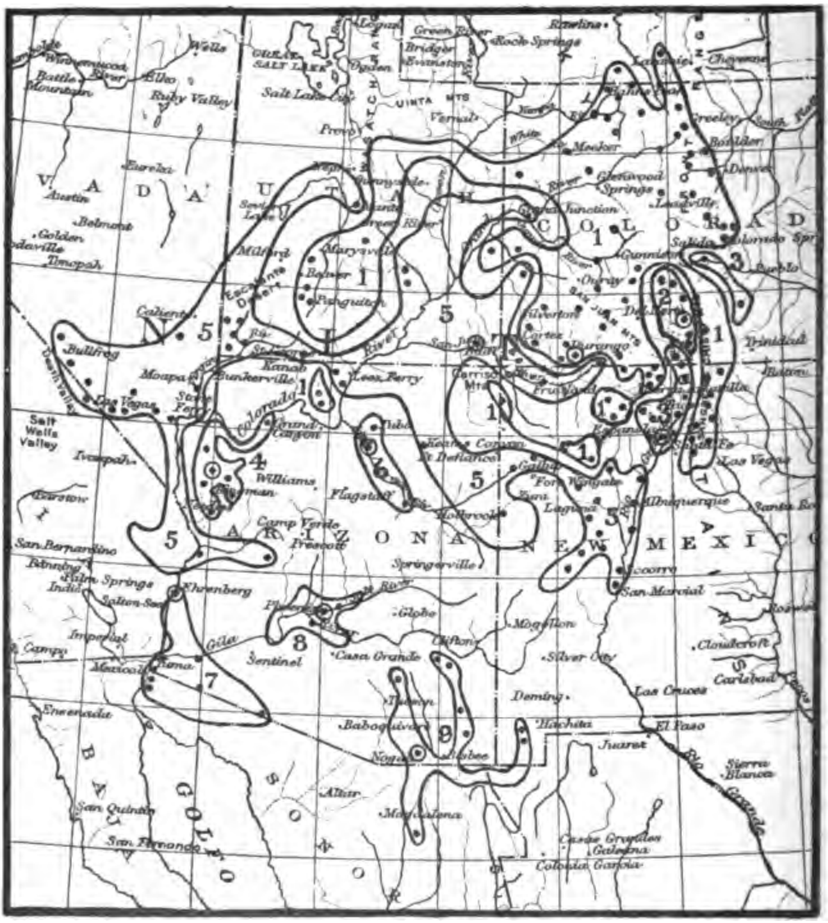

FIG. 8.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

1. *fossor*.
2. *agrestis*.
3. *pervagus*.
4. *desertorum*.
5. *aureus*.
6. *latirostris*.
7. *chrysonotus*.
8. *cervinus*.
9. *intermedius*.

Wyo., where *T. bridgeri* is abundant in meadows and the little *T. ocius* in sagebrush only a few rods away; at Bear River, Wyo., where *T. pygmæus* holds the same relation to *T. bridgeri*; in western Nevada, where the small *T. fisheri* evidently keeps out in the sagebrush to avoid the big *T. nevadensis;* and in Idaho, where *T. townsendi* holds the rich bottoms and the little *T. idahoensis* the dry sagebrush borders. Where

T. monticola meets the various forms of the *bottæ* group along the west slope of the Sierra Nevada, and other species along the east slope of the range, the line of demarcation seems to be sharp, without actual overlapping of the species, although one form may lap well past the other in close juxtaposition, showing an apparent but not real overlapping of range. The two forms generally occupy different life zones, or different types of ground, or else divide the territory on

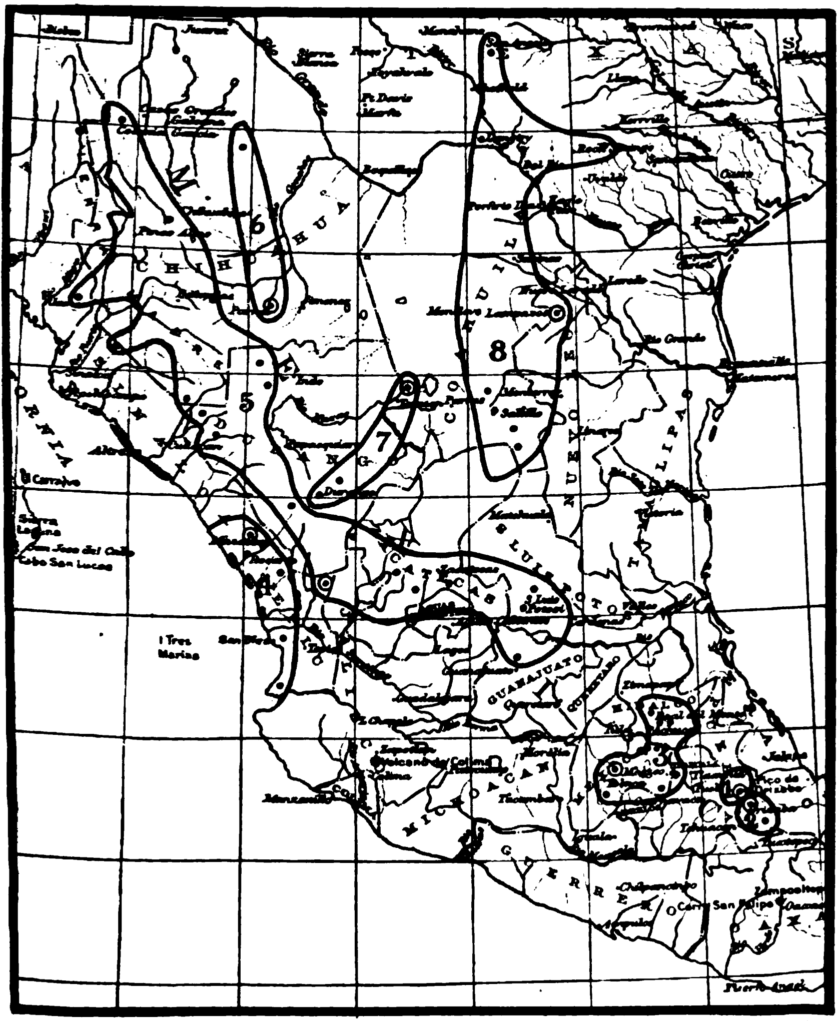

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FIG. 9.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

1. *umbrinus.*
2. *orizabæ.*
3. *peregrinus.*
4. *atrovarius.*
5. *sheldoni.*
6. *nelsoni.*
7. *goldmani.*
8. *perditus.*

some other logical basis. This peculiarity of distribution is exemplified by many species and seems to be universal between the slender-

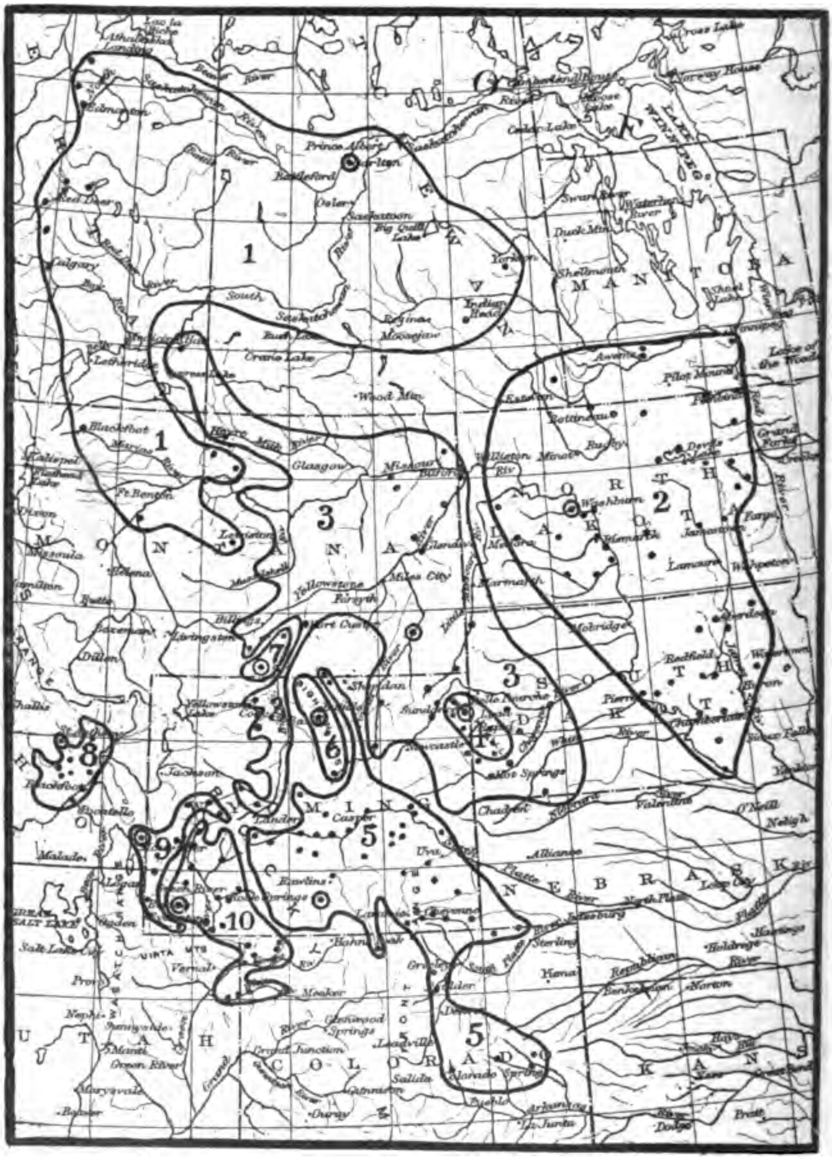

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FIG. 10.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

1. *talpoides*.
2. *rufescens*.
3. *bullatus*.
4. *nebulosus*.
5. *clusius*.
6. *caryi*.
7. *pryori*.
8. *idahoensis*.
9. *pygmæus*.
10. *ocius*.

and deep-rostrum groups. Further and more careful study, however, is needed to determine its cause.

The more nearly related forms generally intergrade or coalesce where their ranges join, some gradually, others abruptly, according to the change of physiographic or climatic conditions.

In Dr. Merriam's phylogenetic tree of the Geomyidæ,[1] *Thomomys* is given as one of the lower branches. The great numbers of genera and species of the family represented in southern Mexico and Central America are spoken of as of the utmost interest in view of the time and place of origin of the family to which they belong.[2] If, as seems probable, the family originated in tropical Mexico and Central America, *Thomomys* has pushed out to the greatest distance of any genus in the family and now reaches from Boca del Monte (near Orizaba), Vera Cruz, Mexico, north to Edmonton, Alberta, and from eastern North Dakota to the Pacific coast.

Over this vast region the species occupy every life zone from the Tropical to the Arctic Alpine, and the greatest extremes of heat and cold, dryness and humidity, light and shade to which the area is subject. Although living underground and being partially nocturnal in habits, the animals respond perfectly to environmental conditions and vary in color according to light and shade, in claws and incisor teeth according to soil texture, in length of fur according to temperature, and in size and form of ears in accordance with length of fur. Thus the great number of recognizable forms is a direct result of the wide distribution and adaptation of a plastic group. The temptation to theorize beyond the limits of actual knowledge in treating such a group is difficult to resist.

The boundaries of ranges of the recognized forms follow closely the border lines of known physiographic or climatic areas. Many forms occupy definite divisions of a life zone, or, in some cases, as on a mountain slope or on several different mountain slopes, extend regularly through a section of two or rarely three life zones, maintaining their boundary lines with surprising accuracy. On some steep and narrow mountain peaks or ranges, however, a valley species will extend up and down the sides through several climatic zones without undergoing noteworthy change.

Permanent residence in a given region seems necessary for noticeable change of characters, and even very restricted but very strongly characterized areas have developed well-marked forms. Species with the widest range are *T. talpoides* and *T. rufescens* of the great plains and prairies of the Saskatchewan and Dakota regions, or *T. fuscus* and *T. fossor* of the Canadian Zone areas of the Rocky Mountains. Some interior valley forms also have extensive ranges, but to the south and west, as the country becomes more broken and irregular, the recognizable forms of *Thomomys* become more numerous and local. California leads in the number of species, partly from its size and great diversity of climatic and physical features and partly from the fact that it has been the most thoroughly studied of the Western States. The magnificent series of specimens in the Museum of Vertebrate Zoology of the University of California has not only added to the number of species known in the State, but has greatly helped in defining the ranges of local species and correlating them with the distribution areas.

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[1] N. Am. Fauna No. 8, 24, 1895.

[2] Ibid., 28.

MATERIAL EXAMINED.

In the present study of the genus *Thomomys* over 7,300 specimens have been examined. Of these, 4,166 are in the Biological Survey collection and 475 in the other collections of the National Museum. Of the remaining specimens examined, 1,755 are in the Museum of Vertebrate Zoology, 276 in the American Museum of Natural History, 234 in the Field Museum of Natural History, 177 in the Museum of Comparative Zoology, 131 in the Stanford University collection, 90 in the Academy of Natural Sciences of Philadelphia collection, and smaller numbers from the Victoria Memorial Museum, the Provincial Museum of British Columbia, the Kansas University collection, the Oregon Fish and Game Commission collection at Reed College, the California Academy of Sciences collection, the North Dakota Agricultural College Museum collection, and private collections of Mr. E. R. Warren, Mr. Stanley G. Jewett, Mr. W. D. Hollister, Dr. William Bebb, and Mr. Ernest Thompson Seton.

For the use of this material, which has in every case been most cordially loaned, my appreciation is elsewhere expressed.

All of the types now in America (83 in number) have been examined, and through the courtesy of Mr. Oldfield Thomas a good photograph of the skull of the type of *T. umbrinus* has been provided and also notes on the old types in the British Museum. Of the eight types not examined, five (*T. talpoides, T. umbrinus, T. atrovarius, T. alticola,* and *T. anitæ*) are in the collection of the British Museum. Good series of topotypes of all of these have been available for study, and also topotypes of *T. bulbivorus* and *T. douglasi,* the types of which appear to be no longer in existence. Unfortunately the type of *T. talpoides* is imperfect, lacking most of the skull, but a good series of virtual topotypes have been available for study.

The type of *T. bottæ* in the Museum d'Histoire Naturelle, at Paris, has not been seen, but large series of specimens from the type region have been examined.

The study of this material shows many localities where a few specimens would throw much light on the zonal distribution and relationships of species, and brings up many problems that can be settled only by careful field study and the collection of specimens at many localities. The distribution maps show many wide areas in which no gophers have been collected and in which the resident species is still unidentified.

The character of the specimens has generally been such as to render the study most profitable. Well-made skins with cleaned skulls, in series sufficient to show variation due to sex, age, and abnormalities, have greatly simplified the task of classification. The skulls of a few specimens collected on early expeditions have been removed and cleaned and for the first time studied in relation to ample material. In this way errors in the former use of names have been corrected.

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The greater part of the present revision was completed through a study of specimens in the Biological Survey collection, but without the additional material in other museums and private collections the results would have been very imperfect. The friendly assistance and cordial cooperation of the leading museums in the United States and Canada and of private collectors have done much toward making possible the results thus far obtained.

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Genus THOMOMYS Wied.

Thomomys Wied, Nova Acta Acad. Cæs. Leop.-Carol., XIX, pt. 1, 378, 1839. **Type,** *Thomomys rufescens* Wied.

GENERIC CHARACTERS.

Upper and lower molars with both anterior and posterior enamel plate always present. Upper incisors with plain, slightly rounded anterior surface, a minute groove near inner edge of each. In some species, notably *T. bulbivorus*, *T. leucodon*, and *T. umbrinus*, the groove is very obscure and can be detected only with a lens; in others, especially the *monticola* group, it is relatively deep, well defined, and readily seen with the naked eye. In species where the inner groove is obscure there is often a trace of a median line of depression along the front of the incisor, but it is a mere trace, difficult to detect and not sufficiently constant to serve as a diagnostic character. Fore feet relatively much slenderer and claws lighter than in other genera of the family, but claws long and well adapted to burrowing.

GROUP RELATIONSHIPS.

In the present paper the species are arranged so far as possible in accordance with their relationships. There are no superspecific divisions of sufficient value to be accorded subgeneric rank, but related species have characters in common which distinguish them as a group from other groups.

The lower outline of the rostrum is the strongest division character, and this, though slight, seems clearly to separate two great groups. In one group the rostrum is deep and heavy in side view, and its lower outline slopes rather evenly from the anterior base of the upper molars to near the base of the incisors. This group includes *T. bulbivorus*, *T. townsendi*, *T. bottæ*, *T. alpinus*, *T. perpallidus*, *T. fulvus*, *T. umbrinus*, and related species. In the other group the rostrum is relatively slender in side view and its lower outline is abruptly arched in front of the upper molars. This group includes *T. talpoides*, *T. fossor*, *T. douglasi*, *T. monticola*, *T. fuscus*, and related species. In the text this division falls on page 96, the slender-rostrum group beginning with *T. talpoides* and continuing to the end. The species of these two groups seem not to intergrade.

HEAVY ROSTRUM GROUPS.

In the heavy rostrum groups are seven divisions, not all of equal distinctness.

Thomomys bulbivorus stands by itself because of its concave pterygoids, small claws, and peculiar fur; but it is not very distant from the *bottæ* group with which it agrees in arrangement of mammæ in 4 pairs.

The *townsendi* group also stands close to the *bottæ* group, as shown by the number and arrangement of mammæ; projecting, obscurely grooved incisors; and short, wide skull.

The *bottæ* group is large, variable, and not sharply separated from the *perpallidus* and *fulvus* groups; all of them agree in number and arrangement of mammæ, short ears, and many other characters. All the forms except *T. magdalenæ* and *T. b. russeolus* are dark or light ochraceous, and it is doubtful whether these two pale forms may not really belong to the *perpallidus* group, with which they agree in distinctly grooved incisors.

The *alpinus* group includes long, narrow-skulled, dark-colored, rather large-eared forms from high up in separate mountain ranges. The mammæ are as in the *bottæ* group. The incisors are abruptly decurved and distinctly grooved.

The *perpallidus* group includes mainly pale desert forms with very small ears, but has no very distinctive group characters. The incisors are abruptly decurved and distinctly grooved.

The *fulvus* group includes several mountain forms of rather bright tawny shades, and paler tawny valley forms in the surrounding country. Some strongly resemble forms of the *umbrinus* group, but all have the mammæ in 4 pairs (2 of inguinal and 2 of pectoral). The incisors are slightly projecting in some species. All are distinctly grooved.

The *umbrinus* group is characterized by 3 pairs of mammæ (2 of inguinal and 1 of pectoral); by relatively short, wide skulls; by projecting, obscurely grooved incisors; and, in most species, by indented or straight anterior base of zygomata.

SLENDER ROSTRUM GROUPS.

In the slender rostrum groups are five subdivisions, none very strongly marked, but all with distinctly grooved incisors.

The *talpoides* group is best characterized by 6 pairs of mammæ (2 of inguinal, 2 of abdominal, and 2 of pectoral), by medium-sized ears, and by general gray coloration.

The *fossor* group is distinguished by 5 pairs of mammæ (2 pairs of inguinal and 3 of pectoral) and by generally brownish coloration. In the three mountain forms the ears are rather large, but in the two valley forms (*T. quadratus* and *T. fisheri*) the ears are very small.

The *douglasi* group and the two following are distinguished by 4 pairs of mammæ (2 of inguinal and 2 of pectoral).

The *monticola* group is very similar to the *douglasi* group, but has slightly larger and more pointed ears and generally more slender skulls.

The *fuscus* group is distinguished by very small, pointed ears and light brown color.

List of Species and Subspecies, with Type Localities.

Thomomys bulbivorus group (pp. 40–42):	
Thomomys bulbivorus (Richardson)	Portland, Oreg.
Thomomys townsendi group (pp. 42–45):	
Thomomys townsendi townsendi (Bachman)	Nampa, Idaho (?).
townsendi nevadensis Merriam	Austin, Nev.
Thomomys bottæ group (pp. 45–63):	
Thomomys bottæ bottæ (Eydoux & Gervais)	"Coast of California."
bottæ laticeps Baird	Humboldt Bay, Cal.
bottæ leucodon Merriam	Grants Pass, Oreg.
bottæ navus Merriam	Red Bluff, Cal.
bottæ mewa Merriam	Raymond, Cal.
bottæ minor Bailey	Fort Bragg, Cal.
bottæ diaboli Grinnell	Diablo Range, Cal.
bottæ angularis Merriam	Los Banos, Cal.
bottæ pascalis Merriam	Fresno, Cal.
bottæ pallescens Rhoads	Grapeland, Cal.
bottæ infrapallidus Grinnell	Carrizo Plain, Cal.
bottæ nigricans Rhoads	Witch Creek, Cal.
bottæ puertæ Grinnell	La Puerta, Cal.
bottæ anitæ Allen	Santa Anita, Lower California.
bottæ alticolus Allen	Sierra Laguna, Lower California.
bottæ russeolus Nelson & Goldman	San Angel, Lower California.
magdalenæ Nelson & Goldman	Magdalena Island, Lower California.
altivallis Rhoads	San Bernardino Mountains, Cal.
Thomomys alpinus group (pp. 63–68):	
Thomomys alpinus alpinus Merriam	Mount Whitney, Cal.
alpinus awahnee Merriam	Yosemite Valley, Cal.
neglectus Bailey	San Gabriel Mountains, Cal.
jacinteus Grinnell & Swarth	Round Valley, San Jacinto Mountains, Cal.
martirensis Allen	San Pedro Martir Mountains, Lower California.
Thomomys perpallidus group (pp. 68–80):	
Thomomys perpallidus perpallidus Merriam	Palm Springs, Cal.
perpallidus albatus Grinnell	Near Pilot Knob, Cal.
perpallidus chrysonotus Grinnell	Ehrenburg, Ariz.
perpallidus perpes Merriam	Lone Pine, Cal.
perpallidus canus Bailey	Deep Hole, Nev.
perpallidus aureus Allen	Bluff, Utah.
perpallidus apache Bailey	Lake La Jara, N. Mex.
cabezonæ Merriam	Cabezon, Cal.
operarius Merriam	Keeler, Cal.
latirostris Merriam	Tanners Crossing of Little Colorado River, Ariz.
cervinus Allen	Phoenix, Ariz.
sinaloæ Merriam	Altata, Sinaloa, Mexico.

Thomomys fulvus group (pp. 80–89):	
Thomomys fulvus fulvus (Woodhouse)	San Francisco Mountains, Ariz.
fulvus pervagus Merriam	Espanola, N. Mex.
fulvus desertorum Merriam	Mud Spring, Detrital Valley, Ariz.
fulvus intermedius Mearns	Huachuca Mountains, Ariz.
fulvus texensis Bailey	Davis Mountains, Tex.
fulvus toltecus Allen	Colonia Juarez, Chihuahua, Mexico.
mearnsi Bailey	Animas Valley, N. Mex.
baileyi Merriam	Sierra Blanca, Tex.
lachuguilla Bailey	El Paso, Tex.
Thomomys umbrinus group (pp. 89–96):	
Thomomys umbrinus umbrinus (Richardson)	Boca del Monte, Vera Cruz, Mexico (?).
umbrinus orizabæ Merriam	Mount Orizaba, Puebla, Mexico.
umbrinus peregrinus Merriam	Salazar, Mexico, Mexico.
nelsoni Merriam	Parral, Chihuahua, Mexico.
sheldoni nobis	Santa Teresa, Tepic, Mexico.
goldmani Merriam	Mapimi, Durango, Mexico.
perditus Merriam	Lampazos, Nuevo Leon, Mexico.
atrovarius Allen	Tatemales, Sinaloa, Mexico.
Thomomys talpoides group (pp. 96–110):	
Thomomys talpoides talpoides (Richardson)	Fort Carlton, Saskatchewan, Canada.
talpoides rufescens Wied	Fort Clark, N. Dak.
talpoides clusius Coues	Bridgers Pass, Wyo.
talpoides bullatus Bailey	Powderville, Mont.
talpoides nebulosus Bailey	Sand Creek (Black Hills), Wyo.
talpoides caryi Bailey	Big Horn Mountains, Wyo.
talpoides pryori Bailey	Pryor Mountains, Mont.
talpoides agrestis Merriam	Medano Ranch, San Luis Valley, Colo.
columbianus Bailey	Touchet, Wash.
ocius Merriam	Fort Bridger, Wyo.
idahoensis Merriam	Birch Creek, Idaho.
pygmæus Merriam	Montpelier Creek, Idaho.
Thomomys fossor group (pp. 111–116):	
Thomomys fossor Allen	Florida, Colo.
bridgeri Merriam	Fort Bridger, Wyo.
uinta Merriam	Uinta Mountains, Utah.
quadratus quadratus Merriam	The Dalles, Oreg.
quadratus fisheri Merriam	Beckwith, Cal.
Thomomys douglasi group (pp. 116–121):	
Thomomys douglasi douglasi (Richardson)	Fort Vancouver, Wash.
douglasi oregonus Merriam	Oregon City, Oreg.
douglasi yelmensis Merriam	Tenino, Wash.
douglasi melanops Merriam	Olympic Mountains, Wash.
limosus Merriam	White Salmon, Wash.
niger Merriam	Seaton, Oreg.
Thomomys monticola group (pp. 121–126):	
Thomomys monticola monticola Allen	Mount Tallac, Cal.
monticola mazama Merriam	Anna Creek, near Crater Lake, Oreg.
monticola pinetorum Merriam	Sisson, Cal.
monticola nasicus Merriam	Farewell Bend, Deschutes River, Oreg.
monticola helleri Elliot	Goldbeach, Oreg.

Thomomys fuscus group (pp. 126–131):

Thomomys fuscus fuscus Merriam	Head of Big Lost River, Idaho.
fuscus saturatus Bailey	Silver (near Saltese), Mont.
fuscus loringi Bailey	South Edmonton, Alberta, Canada.
fuscus myops Merriam	Conconully, Wash.
hesperus Merriam	Tillamook, Oreg.

Key to Groups of Related Species.

a^1. Rostrum deep and evenly sloping in front of upper molars.
b^1. Pterygoids concave on inner surface and convex on outer; mammæ in 4 pairs, **bulbivorus** group (p. 40).
b^2. Pterygoids flat and straight.
c^1. Mammæ in 3 pairs (inguinal, 2–2; pectoral, 1–1)...... **umbrinus** group (p. 89).
c^2. Mammæ in 4 pairs (inguinal, 2–2; pectoral, 2–2).
d^1. Skull short and wide; color mainly dark or light ochraceous, **bottæ** group (p. 45).
d^2. Skull not conspicuously short and wide.
e^1. Skull long and narrow; color dark.................. **alpinus** group (p. 63).
e^2. Skull not conspicuously long and narrow; color mainly pale.
f^1. Color pale buffy yellowish, or gray and black.
g^1. Color buffy or yellowish (except *apache*)... **perpallidus** group (p. 68).
g^2. Color gray and black...................... **townsendi** group (p. 42).
f^2. Color tawny (light or dark tawny).............. **fulvus** group (p. 80).
a^2. Rostrum slender, abruptly arched in front of upper molars.
b^1. Mammæ in 6 pairs or more (inguinal, 2–2; abdominal, 2–2; pectoral, 2–2), **talpoides** group (p. 96).
b^2. Mammæ in 4 or 5 pairs.
c^1. Mammæ in 5 pairs (inguinal, 2–2; pectoral, 3–3)......... **fossor** group (p. 111).
c^2. Mammæ in 4 pairs (inguinal, 2–2; pectoral, 2–2).
d^1. Ears rather large and rounded at tips.............. **douglasi** group (p. 116).
d^2. Ears large or small and pointed at tips.
e^1. Ears relatively large and pointed.............. **monticola** group (p. 121).
e^2. Ears relatively small and pointed................. **fuscus** group (p. 126).

Key to Species and Subspecies of Thomomys.

[Measurements in millimeters.]

a^1. Size large; hind foot of ♂ 38 or more.
b^1. Color uniformly dark sooty brown above and below; hind foot of ♂ 40 or more, **bulbivorus** (p. 40).
b^2. Color gray or black (dichromatic); hind foot of ♂ 38, of ♀ 35.
c^1. Color in gray phase dark buffy gray .... **townsendi** (p. 42).
c^2. Color in gray phase light buffy gray .... **nevadensis** (p. 44).
a^2. Size medium or small.
b^1. Size very small, hind foot of ♂ averaging 26 or less; color buffy gray or brown.
c^1. Color buffy gray.
d^1. Hind foot of ♂ averaging 26................................ **ocius** (p. 107).
d^2. Hind foot of ♂ averaging 23.......................... **idahoensis** (p. 108).
c^2. Color light brown.
d^1. Hind foot of ♂ averaging 25............................... **myops** (p. 130).
d^2. Hind foot of ♂ averaging 22 (smallest of the genus)...... **pygmæus** (p. 109).

- b^2. Size medium, hind foot of ♂ averaging over 26 and under 36.
  - c^1. Color brown, mainly cinnamon-hazel, chestnut, or russet.
    - d^1. Color dark and rich browns.
      - e^1. No conspicuous black on nose and face; hind foot of ♂ about 30, **limosus** (p. 120).
      - e^2. Much blackish on nose and face.
        - f^1. Size smaller, hind foot of ♂ about 27 .... **hesperus** (p. 131).
        - f^2. Size larger, hind foot of ♂ about 29.
          - g^1. Skull with very small oval interparietal .... **melanops** (p. 119).
          - g^2. Skull with large triangular interparietal .... **helleri** (p. 126).
    - d^2. Color light, or bright or dull browns.
      - e^1. Ears small but pointed and well formed.
        - f^1. Color light brown; hind foot of ♂ about 27.
          - g^1. Slightly paler; molars lighter .... **fuscus** (p. 126).
          - g^2. Slightly darker; molars heavier .... **loringi** (p. 129).
        - f^2. Color duller and darker shades of brown; size larger.
          - g^1. Skull very long and narrow; hind foot of ♂ about 29. **saturatus** (p. 128).
          - g^2. Skull relatively short and wide.
            - h^1. Incisors projecting beyond tip of nasals; hind foot of ♂ 29, **pryori** (p. 104).
            - h^2. Incisors not projecting beyond tip of nasals.
              - i^1. Nasals truncate at posterior tip; hind foot of ♂ 27, **quadratus** (p. 114).
              - i^2. Nasals emarginate at posterior tip; hind foot of ♂ 28, **caryi** (p. 104).
      - e^2. Ears relatively long and pointed.
        - f^1. Color dull brown.
          - g^1. Size larger, hind foot of ♂ averaging 33 .... **bridgeri** (p. 112).
          - g^2. Size smaller, hind foot of ♂ under 33.
            - h^1. Bullæ large; posterior tip of nasals rounded .... **fossor** (p. 111).
            - h^2. Bullæ smaller; posterior tip of nasals emarginate.... **uinta** (p. 113).
        - f^2. Color bright, warm browns.
          - g^1. Size larger, hind foot of male averaging about 30.
            - h^1. Skull relatively short and wide; interparietal triangular, **oregonus** (p. 117).
            - h^2. Skull long and narrow; interparietal small and oval.
              - i^1. Zygomatic arches widest anteriorly .... **douglasi** (p. 116).
              - i^2. Zygomatic arches widest posteriorly .... **yelmensis** (p. 118).
          - g^2. Size smaller, hind foot of ♂ about 28 or less.
            - h^1. Color russet; bullæ full and rounded .... **mazama** (p. 123).
            - h^2. Color hazel; bullæ relatively small and angular.
              - i^1. Color dull hazel; braincase very narrow .... **monticola** (p. 121).
              - i^2. Color more yellowish hazel; braincase wider.
                - j^1. Nasals longer and conspicuously widened anteriorly, **nasicus** (p. 125).
                - j^2. Nasals shorter and merely cuneate .... **pinetorum** (p. 124).
  - c^2. Color not distinctly brown, but of various shades of ochraceous, tawny, buff, gray, umber, or black.
    - d^1. Color strongly ochraceous.
      - e^1. Incisors projecting conspicuously beyond tip of nasals.
        - f^1. Color dark ochraceous, clouded with dusky in winter.
          - g^1. Size large, hind foot of ♂ averaging 33 .... **bottæ** (p. 45).
          - g^2. Size smaller, hind foot of ♂ not over 30.
            - h^1. Color darker than in *bottæ* .... **minor** (p. 51).
            - h^2. Color lighter than in *bottæ* .... **diaboli** (p. 51).

f^2. Color light, bright, or rusty ochraceous.
  g^1. Color light or bright ochraceous.
    h^1. Color bright ochraceous; skull heavy and angular, **angularis** (p. 53).
    h^2. Color pale ochraceous; skull not heavy and angular, **infrapallidus** (p. 55).
  g^2. Color rusty ochraceous.
    h^1. Incisors heavy and not greatly projecting.......... **laticeps** (p. 46).
    h^2. Incisors slender and greatly projecting.
      i^1. Hind foot of ♂ 30 to 33.......................... **leucodon** (p. 47).
      i^2. Hind foot of ♂ 27 to 30.............................. **navus** (p. 49).
e^2. Incisors not projecting conspicuously beyond tip of nasals.
f^1. Color light ochraceous.
  g^1. Size large, hind foot of ♂ averaging about 32.
    h^1. Bullæ large; skull short and wide.................. **pascalis** (p. 54).
    h^2. Bullæ small; skull long and narrow............ **pallescens** (p. 55).
  g^2. Size smaller, hind foot of ♂ averaging 30 or less.
    h^1. Underparts buffy or whitish...................... **cabezonæ** (p. 76).
    h^2. Underparts light ochraceous.......................... **puertæ** (p. 58).
f^2. Color dark ochraceous, or ochraceous heavily clouded with black.
  g^1. Size large, hind foot averaging 34.................. **altivallis** (p. 62).
  g^2. Size medium or small.
    h^1. Size small, hind foot of ♂ about 27.
      i^1. Skull narrow.................................. **awahnee** (p. 64).
      i^2. Skull wide.. **mewa** (p. 50).
    h^2. Size medium, hind foot of ♂ averaging 30–32.
      i^1. Dorsal outline of skull arched, rostrum decurved.
        j^1. Interpterygoid fossa wide, not sharply V-shaped, **apache** (p. 75).
        j^2. Interpterygoid fossa narrow, sharply V-shaped.
          k^1. Throat usually white, interparietal large and quadrate, **alpinus** (p. 63).
          k^2. Throat rarely white, interparietal small and often triangular.
            l^1. Premaxillæ wide......................... **alticolus** (p. 60).
            l^2. Premaxillæ narrow.
              m^1. Skull very long and narrow....... **martirensis** (p. 67).
              m^2. Skull not very long and narrow....... **nigricans** (p. 56).
      i^2. Dorsal outline of skull straight, rostrum not decurved.
        j^1. Zygomatic arches widest posterior to middle; nasals emarginate, **neglectus** (p. 65).
        j^2. Zygomatic arches widest anterior to middle; nasals usually truncate.................................. **jacinteus** (p. 66).
d^2. Color not strongly ochraceous.
e^1. Color tawny, varying from dark to bright and pale tawny.
f^1. Size large, hind foot of ♂ averaging 31 or more.
  g^1. Color bright tawny.
    h^1. Tail, feet, and belly well haired.................. **pervagus** (p. 82).
    h^2. Tail, feet, and belly very thinly haired.
      i^1. Skull short and wide.............................. **sinaloæ** (p. 80).
      i^2. Skull long and relatively narrow.................. **anitæ** (p. 59).
  g^2. Color dull tawny, bordering on buffy and fawn.
    h^1. Hind foot of ♂ averaging 34 or more............. **cervinus** (p. 79).
    h^2. Hind foot of ♂ averaging about 31 or less.
      i^1. Color dull tawny.............................. **toltecus** (p. 86).
      i^2. Color yellowish tawny.......................... **baileyi** (p. 87).

f^2. Size smaller, hind foot averaging 30 or less.

g^1. Color dark tawny, clouded with black in winter pelage.

h^1. Hind foot of ♂ about 30 .... **fulvus** (p. 80).

h^2. Hind foot of ♂ about 27.

i^1. Color dark, bordering on umber .... **intermedius** (p. 84).

i^2. Color brighter with less black on back .... **texensis** (p. 85).

g^2. Color bright or pale tawny.

h^1. Color very bright tawny.

i^1. Incisors not conspicuously protruding beyond nasals, **desertorum** (p. 83).

i^2. Incisors conspicuously protruding beyond nasals.

j^1. Belly pale tawny .... **nelsoni** (p. 92).

j^2. Belly white or yellow.

k^1. Belly white .... **goldmani** (p. 94).

k^2. Belly yellow .... **mearnsi** (p. 87).

h^2. Color pale tawny.

i^1. Color brighter, more buffy tawny .... **lachuguilla** (p. 88).

i^2. Color duller, more grayish tawny .... **perditus** (p. 95).

e^2. Color not tawny.

f^1. Color buff or orange, varying from light buff to rich orange-buff.

g^1. Color bright orange-buff or buffy yellow.

h^1. Size large, hind foot of type (♂ ad.) 36 .... **magdalenæ** (p. 61).

h^2. Size smaller, hind foot not over 33.

i^1. Zygomatic arches abruptly constricted posteriorly, **operarius** (p. 77).

i^2. Zygomatic arches not abruptly constricted posteriorly.

j^1. Rostrum very broad .... **latirostris** (p. 78).

j^2. Rostrum less broad .... **aureus** (p. 74).

g^2. Color buff or grayish buff.

h^1. Color grayish buff.

i^1. Size large, hind foot of ♂ about 33 .... **canus** (p. 73).

i^2. Size smaller, hind foot of ♂ about 30 .... **perpes** (p. 72).

h^2. Color clear yellowish buff.

i^1. Size large, hind foot of ♂ averaging 34 .... **albatus** (p. 70).

i^2. Size smaller, hind foot of ♂ about 30.

j^1. Nasals conspicuously truncate posteriorly .... **russeolus** (p. 60).

j^2. Nasals usually slightly emarginate posteriorly.

k^1. Skull narrow and slender .... **perpallidus** (p. 68).

k^2. Skull short and wide .... **chrysonotus** (p. 71).

f^2. Color not buff or orange.

g^1. Color gray, varying from light to dark brownish gray.

h^1. Color dark brownish gray; claws stout; ears larger.

i^1. Audital bullæ long but not full and rounded.

j^1. Skull not heavily ridged in old ♂, hind foot about 30, **talpoides** (p. 96).

j^2. Skull heavily ridged in old ♂, hind foot about 31, **rufescens** (p. 98).

i^2. Audital bullæ full and rounded.

j^1. Color lighter, bullæ larger .... **bullatus** (p. 102).

j^2. Color darker, bullæ smaller .... **nebulosus** (p. 103).

h^2. Color light brownish gray or pale gray; claws slender; ears smaller.

i^1. Audital bullæ large and globose.

j^1. Color very pale gray .... **agrestis** (p. 105).

j^2. Color not so pale gray .... **clusius** (p. 100).

i^2. Audital bullæ relatively narrower.
j^1. Size larger, hind foot of ♂ about 28....**columbianus** (p. **106**).
j^2. Size smaller, hind foot of ♂ about 26 ....**fisheri** (p. **115**).
g^2. Color not gray, but dark or light umber or black.
h^1. Incisors abruptly decurved, inner groove conspicuous; color always black..**niger** (p. **121**).
h^2. Incisors conspicuously projecting beyond nasals, inner groove very obscure; color not always black.
i^1. Color generally black (dark umber in a few individuals), **orizabæ** (p. **90**).
i^2. Color dark or light umber (black in a few individuals).
j^1. Color dark umber.
k^1. Feet, tail, and belly almost naked.......**atrovarius** (p. **95**).
k^2. Feet, tail, and belly with normal covering of hair.
l^1. Skull very short and wide; color very dark, **umbrinus** (p. **89**).
l^2. Skull less short and wide; color bright..**peregrinus** (p. **91**).
j^2. Color light umber ....**sheldoni** (p. **93**).

Description and Distribution of Species and Subspecies.

Thomomys bulbivorus Group.

THOMOMYS BULBIVORUS (RICHARDSON).

CAMAS POCKET GOPHER (Camas Rat of Richardson).

(Pl. II, fig. 1; Pl. III, fig. 1.)

Diplostoma bulbivorum Richardson, Fauna Boreali-Americana, I, 206, 1829.
Geomys bulbivorus Richardson, Ann. Rept. Brit. Assn. for 1836, VI, 150, 1837.
Ascomys bulbivorus Wagner, Suppl. Schreber, III, 388, 1843.
Pseudostoma bulbivorum Audubon & Bachman, Quad. N. Am., III, 337, 1854.
Geomys (*Thomomys*) *bulbivorus* Giebel, Säug. 530, 1855.
Thomomys bulbivorus Brandt, Beit. Kennt. Säug. Russl., 188, 1855.—Allen, Bul. Am. Mus. Nat. Hist., V, 56, April 28, 1893.—Miller, Proc. Biol. Soc. Washington, VIII, 113, Aug. 6, 1893.
Thomomys [sub-genus *Megascapheus*] *bulbivorus* Elliot, Field Columbian Mus., zool. ser. III, 190, May, 1903.

Type.—Collected on "Banks of the Columbia River, Oregon," probably Portland, the only place near the Columbia River where it has since been taken. The type is said to have been in the Hudson Bay Museum, but Oldfield Thomas writes (Mar. 15, 1915) that it is not now in the British Museum collection.

Distribution.—Willamette Valley, Oreg., from Portland and Forest Grove south to Eugene; west to Grand Ronde (fig. 5).

Characters.—Largest known species of the genus; hind foot of adult male 40–43 mm.; front claws small and weak; external ear merely a thickened rim; tail almost naked; winter coat long and furry; summer coat short and harsh; color dark brown or sooty, nearly concolor above and below; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2, with 4 separate mammary glands.

Color.—*Winter pelage:* Dark sooty brown, the plumbeous basal color showing through on belly; ears and nose blackish; chin and throat and usually small anal patch white; feet usually streaked or mottled with white. *Summer pelage:* Washed with rusty brown above and below. *Young:* Like summer adults but very thinly haired, the skin showing through on belly.

Skull.—Short and wide with zygomatic arches usually widest posteriorly; rostrum, slender; nasals short, falling considerably short of premaxillæ at both ends; pterygoids convexly inflated and divided by narrow fossa; bullæ rather small and narrow but auditory meatus unusually open or dilated. *Dentition* rather light; incisors slender, greatly protruding, and usually white tipped; groove on inner edge of upper incisors very obscure.

Measurements.—Average of 5 adult males from Salem and Beaverton, Oreg.: Total length, 300; tail vertebræ, 90; hind foot, 42. Largest male: 302, 99, 43. Average of 4 adult females: 271, 81, 39. *Skull* (♂ ad.):[1] Basal length, 52; greatest length over incisors, 57; nasals, 19; zygomatic breadth, 36.5; mastoid breadth, 30.5; alveolar length of upper molar series, 10.

Remarks.—This is the most aberrant form of the genus, marking either an ancestral type or more probably a highly specialized development of adaptive characters. Widely separated geographically from the *bottæ* group, with which it shows the closest affinities, it is entirely isolated in the humid, rich-soiled valley of the Willamette.

The object of the projecting incisors becomes evident when these gophers are trapped. During the dry season the soil of the Willamette Valley becomes baked and so hard that digging open gopher holes with a small shovel, knife, or sharp stick is difficult, and but for a granular cleavage would be almost impossible. The adobe earth breaks out somewhat as the segments of a pomegranate, but in coarser granules. Evidently the little irregular clay balls making up the gopher hills are pried out with the projecting incisors, which by long use have become perfect miners' picks. The upper incisors project actually beyond the tip of the gopher's nose and at a convenient angle for prying out the earth balls. The lower incisors project equally far but from farther back. The fur-lined lips close behind the incisors, so that no earth can get into the mouth. The short bristly fur surrounding the base of the incisors protects the lips, and leaves the "pick and shovel" teeth free. That the teeth are regularly used for digging is evidenced by the much-worn tips and edges. The white tips are shown by the lens to be due to the wearing away of the yellow enamel surface. The slight inner groove is usually worn entirely away before it reaches the tip of the incisor. It seems highly probable that the unusually weak front claws of this gopher result from their disuse in heavier kinds of digging.

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[1] No. 57322, U. S. Nat. Mus., from Salem, Oreg.

The subgeneric characters ascribed to this species consist of little more than the convex wings of the pterygoids. While this character is unique in the genus it involves only the form of a weak and variable bone and seems too superficial for more than specific value. As there are no other divisions of subgeneric rank in the genus this one seems of doubtful value.

The large mounds of these gophers have been observed in Oregon at Albany, Cottage Grove, Harris, Lyons, and almost continuously along the roads from Salem to a little south and 12 miles east of Eugene.

Specimens examined.—Total number, 62, as follows:

Oregon: Beaverton, 12; Corvallis, 1; Eugene, 8; Gaston, 2; Grand Ronde, 3; McCoy, 6; Mulino, 6; Portland, 5; Salem, 20; Sheridan, 2.

Thomomys townsendi Group.

THOMOMYS TOWNSENDI TOWNSENDI (BACHMAN).

TOWNSEND POCKET GOPHER.

(Pl. II, fig. 2; Pl. III, fig. 2.)

Geomys townsendii Bachman (from Richardson's MS.), Journ. Acad. Nat. Sci. Philadelphia, VIII, pt. 1, 105, 1839.

Thomomys nevadensis atrogriseus Bailey, Proc. Biol. Soc. Washington, XXVII, 118, July 10, 1914. Type locality, Nampa, Idaho.

Type.—Type locality erroneously given as "Columbia River," but probably southern Idaho and very probably near Nampa, where Townsend's party camped to trade with Indians, August 22, 1834. Type specimen in Acad. Nat. Sci. Philadelphia.

Distribution.—Valley of Snake River in southern Idaho, from American Falls to Weiser (fig. 5).

Characters.—Size very large; ears small but pointed; claws medium; mammæ 4 pairs, inguinal, 2–2, pectoral 2–2; color dichromatic, a dark gray phase and a black phase; skull relatively wide and angular.

Color.—In gray phase: Upperparts dark buffy gray or sooty gray; nose and face blackish; ear patch black; feet and tail soiled gray; underparts washed with rich buff; cheek pouches lined with black and white; chin white. In black phase: Dull, slaty black all over except white patch on chin and toes and usually on lower part of feet. There seems to be little seasonal variation except for a general darkening with wear as the buff tips disappear from the hairs. Two specimens from Caldwell, Idaho, collected May 30 and June 3, are clearer, richer buff than any others and much darker and richer even than any specimens of the subspecies *nevadensis*. This may be a normal but rare pelage.

Skull.—Large and wide with spreading zygomatic arches, narrow nasals and rostrum, and short, wide braincase; sagittal and occipital crests well developed in old males; audital bullæ large but depressed to level of basioccipital, rather angular; basioccipital thick and narrow; pterygoids high but short and thickened at margins. *Dentition* heavy; incisors long and slightly projecting; inner groove obscure.

Measurements.—Adult male: Total length, 305; tail vertebræ, 100; hind foot, 38. Adult female: 276, 75, 35. These are about average measurements. *Skull* (♂ ad.): Basal length, 49; nasals, 18; zygomatic breadth, 35; mastoid breath, 29; interorbital breadth, 8; alveolar length of upper molar series, 10.

Remarks.—The type of Bachman's *Geomys townsendii* which evidently was labeled, not by the collector but after it came into the possession of the Academy of Natural Sciences of Philadelphia, "Rocky Mts., J. K. Townsend," is fortunately still extant. Bachman published Richardson's manuscript description of the species in 1839, and stated that it came from the Columbia River. It was a mounted specimen with the skull inside, and its identity has caused much speculation. Through the kindness of Dr. Witmer Stone, of the Academy of Natural Sciences, the type is now before me and the skull has been removed and cleaned. The type is an immature female and much faded, but the skull serves to identify the species at once as one which I recently described under the name *atrogriseus* from southern Idaho. I take pleasure in yielding my recent name in favor of one which for 76 years has been misapplied. In 1834, J. K. Townsend made his journey to the coast of Oregon through southern Idaho, and very probably secured the type of the species named for him near the present town of Nampa, where his party camped August 22 to trade with the Indians.[1] The type locality of *Thomomys townsendi* may therefore be fixed as the vicinity of Nampa, where these large gophers still abound and from which place we have a fine series of specimens.

My *atrogriseus* was described as a subspecies of *nevadensis*, but now *nevadensis* becomes a subspecies of *townsendi* since the latter is the earlier name. The nearest relationships are with the *bottæ* and *perpallidus* groups, but there is probably no direct connection with either at the present time.

Specimens examined.—Total number, 63, as follows:

Idaho: American Falls, 10; Caldwell, 2; Nampa, 19; Payette, 14; Weiser, 4.
Oregon: Ontario, 2; Owyhee, 6; Vale, 6.

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[1] Townsend, J. K., Narrative of a Journey Across the Rocky Mountains to the Columbia River, 136, 1839.

THOMOMYS TOWNSENDI NEVADENSIS Merriam.

Nevada Pocket Gopher.

(Pl. III, fig. 3.)

Thomomys nevadensis Merriam, Proc. Biol. Soc. Washington, XI, 213, 1897.

Type.—Collected at Austin, Nevada (exact locality, bottom of valley about 5 miles west of the town in moist soil near Reese River) by Vernon Bailey, November 11, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Valleys of central and northern Nevada and southeastern Oregon, from Austin and Lovelocks, Nev., north to Alvord Lake, Oreg. (fig. 5).

Characters.—Size large; hind foot 35–40 mm.; skull heavily ridged and angular with projecting incisors; colors dichromatic, buffy gray, or black; in the gray phase more buffy and in the black phase more plumbeous than in *townsendi;* mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—In gray phase: Light buffy gray, slightly paler on belly, feet, and tail; nose and cheeks plumbeous; throat white. In black phase: Bluish black or plumbeous all over except white throat and usually white feet. There is often a small white spot on top of head and the white throat patch extends to breast on some specimens. Intermediate specimens are bluish gray or mixed gray and plumbeous.

Skull.—Heavy and angular with long nasals and rostrum; lateral ridges joined in sagittal crest in old males; zygomatic arches wide spreading with slight median constriction; bullæ large but depressed to plane of basioccipital and with sharp anterior points; basioccipital narrowed between bullæ; pterygoids high, thin, and arched. *Dentition* heavy; incisors slightly projecting; inner groove obscure.

Measurements.—Type (♂ ad.): Total length, 275; tail vertebræ, 90; hind foot, 38. Topotype (♀ ad.): 255, 82, 35. *Skull* (of type): Basal length, 44; nasals, 15.5; zygomatic breadth, 31; mastoid breadth, 26; alveolar length of upper molar series, 9.

Remarks.—None of the type series are in the black phase, but in a series of 15 from Battle Mountain 7 are black, 5 are gray, and 3 are intermediate. Other melanistic specimens come from Halleck, Argenta, Winnemucca, and McDermitt, Nev., and Lake Alvord, Oreg. Like *townsendi*, this gopher inhabits moist fertile valley bottoms and not the surrounding dry sagebrush land. Its range therefore is along stream valleys, and while its close relationship with *townsendi* indicates only subspecific rank, its range is apparently at present not continuous with that form. On the west it is cut off from its next nearest relative—*griseus*—by the Sink of the Humboldt and its desert margins.

Specimens examined.—Total number, 93, as follows:

Nevada: Argenta, 1; Austin, 9; Battle Mountain, 15; Big Creek, 3; Halleck, 5; Independence Valley, 1; Lovelocks, 10; McDermitt, 2; Paradise, 8; Quinn River Crossing, 14; Winnemucca, 7.

Oregon: Alvord, 1; Alvord Lake, 10; Tumtum Lake, 7.

Thomomys bottæ Group.

THOMOMYS BOTTÆ BOTTÆ (Eydoux & Gervais).

California Pocket Gopher.

(Pl. II, fig. 3; Pl. III, fig. 4; text fig. 2.)

Oryctomys (Saccophorus) bottæ Eydoux & Gervais, Mag. de Zool., VI, 23–24, pl. 21, fig. 4, 1836.

Thomomys bottæ Baird, Proc. Acad. Nat. Sci. Philadelphia, VII, 335, 1855.

Thomomys bulbivorus Baird, Mamm. N. Am., 389, 1857. Not *Diplostoma bulbivorum* Richardson.

Type.—Collected on "coast of California," probably at Monterey or San Francisco. Type in "Collection de la Faculté des Sciences," Paris.

Distribution.—Coast region of California, from Sonoma County (Freestone) south to San Diego (fig. 6).

Characters.—Size large, males much larger than females; average of hind foot in males, 33 mm., in females, 28 mm; ears short, a mere thickened rim; color dull, dark yellowish brown, nearly unicolor; skull well arched, heavily ridged, and angular, with slightly projecting incisors; grooves on inner edge of incisors very small; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color— *Winter pelage:* Upperparts dark ochraceous, heavily clouded with black-tipped hairs; underparts lightly washed with dull ochraceous over the plumbeous underfur, often almost as dark as upperparts; ear patch, nose, and cheeks blackish; lips and lining of pockets white; tail usually dusky or brownish gray; feet usually white. *Summer pelage:* Very similar, but slightly brighter, clearer ochraceous.

Skull.—Adult male: Heavy and angular with long, decurved rostrum; lateral ridges occasionally meeting in very old age in sagittal crest; nasals long, cuneate or slightly spatulate, narrow, and generally emarginate posteriorly; auditory meatus large and slightly inflated; bullæ rather depressed and angular; upper incisors projecting slightly beyond tip of nasals. Adult female: Much smaller, slenderer, and less ridged than in males, but with the same arched outline, slender rostrum, and projecting incisors.

Measurements.—Average of 5 adult males from near Monterey: Total length, 267; tail vertebræ, 81; hind foot, 33. Average of 5 females: 219, 69, 28. *Skull* (♂ ad.):[1] Basal length, 45; nasals, 16.5; zygomatic breadth, 29; mastoid breadth, 24; alveolar length of upper molar series, 9. Skull of adult female (from same locality): 36, 13, 24, 19, 8.7.

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[1] No. 107856, U. S. Nat. Mus., from near Monterey, Cal.

Remarks.—In addition to the unusual discrepancy in size of males and females of *bottæ* there is a great range of local variation in specimens from widely separated localities. To the south this subspecies passes into *pallescens;* to the north it intergrades with *minor* and apparently with *leucodon;* to the east it grades into the larger bright-colored *angularis* of the San Joaquin Valley; and along the eastern side of the valley it runs into the paler *pascalis.* But in the coast region it is fairly typical from Bodega on the north to San Diego on the south.

Specimens examined.—Total number, 713, as follows:

California (western): Alameda, 1; Alhambra, 4; Arroyo Seco (Monterey County), 7; Banta, 7; Bear Valley (head of Carmel River), 2; Berkeley, 18; Big Pine Mountains, 2; Bodega, 11; Carmel River, 1; Carmel Valley, 5; Carpenteria, 2; Colma, 1; Cone Peak, 1; Cuyama Valley (Schoolhouse Canyon), 6; Drum Barracks (Los Angeles County), 2; Freestone, 12; Gaviota Pass, 3; Glendora; 6; Half Moon Bay, 1; Haywards, 14; Hernandez (San Benito County), 1, Hueneme, 5; Inverness, 28; Jamesburg, 13; Jolon, 10; Laguna Ranch, 6; Lagunitas, 1; La Honda, 5; Las Virgines Creek, 6; Little Pine Canyon, 1; Los Angeles, 14; Los Gatos, 1; Mansfield, 5; Matilija (Ventura County), 9; Milpitas Ranch (south base Santa Lucia Peak), 1; Mono Flats, 9; Monrovia, 1; Monterey (Pacific Grove and Point Pinos), 34; Morro, 2; Mount Tamalpais, 1; Mountain View (Santa Clara County), 1; Nicasio, 84; Oakland, 1; Olema, 1; Pacific Grove, 1; Palo Alto, 44; Palos Colorados Canyon, 2; Pasadena and vicinity, 22; Pescadero, 7; Pine Creek (Bailey's Ranch), 2; Pine Valley (Monterey County), 7; Petaluma, 6; Pleyto, 6; Point Reyes, 18; Point Sur, 6; Portolo (San Mateo County), 8; Posts, 11; Pozo, 2; Priest Valley, 9; Redwood City, 27; Salinas Valley, 4; San Diego, 8; San Francisco (Golden Gate), 9; San Jose, 2; San Lorenzo, 1; San Mateo, 2; San Simeon, 2; Santa Ana Canyon, 4; Santa Barbara, 1; Santa Clara County, 6; Santa Cruz, 6; Santa Cruz Mountains, 1; Santa Inez, 2; Santa Margarita (San Luis Obispo County), 1; Santa Monica, 3; Santa Paula, 1; Soquel (Santa Cruz County), 2; Stanford, 48; Stanford University, 7; Stony Creek (Monterey County), 1; Sur River, 1; Tassajara Spring (Contra Costa County), 2; Tomales, 18; Tracy and vicinity, 25; Twin Oaks, 13; Union Island, 1; Ventura, 5; Walnut Creek, 16.

THOMOMYS BOTTÆ LATICEPS BAIRD.

HUMBOLDT BAY POCKET GOPHER.

(Pl. III, fig. 6.)

Thomomys laticeps Baird, Proc. Acad. Nat. Sci. Philadelphia, VII, 335, Apr., 1855.

Type.—Collected at Humboldt Bay, California, by Lieut. W. P. Trowbridge, February 21, 1855. Type specimen in U. S. Nat. Mus.

Distribution.—Coast region of northwestern California, from Smith River south to Eel River (fig. 6).

Characters.—Size and general appearance of *bottæ,* but color warmer and brighter and less clouded with black-tipped hairs; skull averaging slightly wider, and nasals especially wider; mammæ in 4 pairs.

Color.—Upperparts uniform clear rusty ochraceous or almost snuff brown, brighter than in *bottæ* and with less black; underparts light buffy ochraceous, in strong contrast with upperparts; feet and distal half of tail and usually lips and chin whitish. Summer and winter pelage identical in all specimens examined.

Skull.—Similar to that of *bottæ*, but slightly wider in proportion to length; middle of malar arch more indented; auditory meatus less inflated; lateral ridges not meeting in old males; nasals wide and not sharply emarginate posteriorly. *Dentition* about the same as in *bottæ* or slightly heavier.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 264: tail vertebræ, 88; hind foot, 33. Average of 5 topotypes (♀ ad.): 226, 77, 30. *Skull* (of topotype, ♂ ad.):[1] Basal length, 43; nasals, 16; zygomatic breadth, 30; mastoid breadth, 23; alveolar length of upper molar series, 9.

Remarks.—The subspecies *laticeps* is closely related to *bottæ*, but seems not to intergrade directly with it, as a smaller form of *bottæ* comes between. It can stand, however, as a well-marked subspecies. Specimens from the region of Humboldt Bay only are typical, while those from Crescent City are slightly paler. Two from Rio Dell may be grading toward *leucodon* and a small female from Alton Junction is doubtfully referred to *laticeps*. Specimens from Cuddeback and Hoopa are clearly intermediate between *laticeps* and *leucodon*, but are referred to the latter.

Specimens examined.—Total number, 90, as follows:

California (coast region of Humboldt and Del Norte Counties): Alton Junction, 1; Arcata (on Humboldt Bay), 49; Crescent City, 10; Eureka, 1; Requa, 6; Rio Dell, 2; Smith River, 2; Table Bluff (on Humboldt Bay), 16; Trinidad, 3.

THOMOMYS BOTTÆ LEUCODON MERRIAM.

WHITE-TOOTHED POCKET GOPHER.

(Pl. II, fig. 11; Pl. III, fig. 5.)

Thomomys leucodon Merriam, Proc. Biol. Soc. Washington, XI, 215, July 15, 1897.

Type.—Collected at Grants Pass, Rogue River Valley, Oregon, by Clark P. Streator, December 17, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Portions of northern California and southwestern Oregon, from Grants Pass, Oreg., south to Fairfield and Placerville, Cal. (fig. 6).

Characters.—Smaller, lighter, and brighter colored than *bottæ;* in winter pelage, very similar in color and markings to *laticeps*, much brighter in summer pelage; skull short and wide, with slender, projecting incisors, which are generally white or white tipped and with obscure inner grooves; mammæ in 4 pairs.

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[1] No. 58452, U. S. Nat. Mus.

Color.—*Winter pelage:* Upperparts uniform dark rusty ochraceous or snuff brown; nose dusky; underparts light buffy ochraceous; feet, chin, and often cheeks and spots on belly white. *Summer pelage:* Upperparts dark cinnamon; underparts clear bright cinnamon.

Skull.—Low and wide with short, wide braincase, wide-spreading zygomatic arches, widest posteriorly, and wide, quadrate, or triangular interparietal; nasals short, deeply emarginate; bullæ small; pterygoids narrowly V-shaped. *Dentition* very light; incisors slender, mainly white or white tipped and projecting far beyond nasals and premaxillæ.

Measurements.—Type (young ♂): Total length, 221; tail vertebræ, 68; hind foot, 29. Topotype (old ♂): 246, 72, 32. Average of 4 topotypes (females): 188, 60, 28. *Skull* (of type): Basal length, 36; nasals, 13; zygomatic breadth, 26; mastoid breadth, 19; interorbital breadth, 6.5; alveolar length of upper molar series, 7. Skull of topotype (old ♂): 41, 15.8, 29, 23.5, 6, 8.

Remarks.—Typical *leucodon* differs widely from typical *bottæ*, but as the gap is largely bridged by the somewhat divergent characters of *navus*, and the chain of intergradation between the two extremes is complete, there is ample ground for grouping not only *leucodon* but *navus* and *mewa* as subspecies under *bottæ*. Only specimens from the Rogue River Valley can be considered typical of *leucodon*, but in spite of much variation specimens occurring over a wide range of rough mountain, valley, and foothill country south to Fairfield, Cal., can better be referred to *leucodon* than to any other form. Skins of Fairfield specimens are indistinguishable from topotypes of *leucodon*, but the skulls are close to *navus*. The principal variation over this range is in a reversion toward the cranial characters of *bottæ* to the southward and a brightening of color in the less humid interior. These brighter-colored specimens are externally very similar to typical *fulvus* of the San Francisco Mountain plateau region of Arizona, but comparison of skulls shows that the resemblance is only superficial. Specimens from Hoopa Valley and Cuddeback are clearly intermediate between *leucodon* and *laticeps* but are listed under *leucodon*. Those from Cuddeback also strongly suggest *bottæ* but are rather small and in this approach *minor*.

Specimens examined.—Total number, 313, as follows:

California: Baird, 3; Battle Creek, 2; Big Valley Mountains, 12; Bartlett Mountain, 5; Berger Creek (Mendocino County), 1; Blue Canyon, 1; Briceland, 6; Burney, 5; Cahto, 1; Calistoga, 2; Cassel, 1; Cuddeback, 9; Dana, 4; Downieville, 1; Dutch Flat, 2; Edgewood (Shasta Valley), 2; Eel River (head of, near South Yolla Bolly Mountain), 1; Fairfield, 6; Fair Oaks, 13; Fall River Mills, 2; Fort Jones, 1; Fyffe, 5; Gazelle, 6; Genesee, 3; Glen Ellen, 2; Gold Run, 6; Goosenest Mountain (Shasta Valley), 1; Greenville, 1; Hayden Hill, 1; Helena, 26; Hoopa Valley, 7; Hornbrook, 10; Indian Valley (Lassen County), 2; Lakeport, 1; Laytonville, 1; Lower Lake, 12; Mad River, near Kunz (Trinity County), 6; Mountain House (Butte County), 8; Mount George, 1; Mount

St. Helena, 3; Mount Sanhedrin (3 miles west of summit), 8; Mount Veeder, 2; Novato, 6; Old Fort Crook, 20; Petaluma, 3; Picard, 9; Placerville, 2; Post Creek, 2; Prattville, 1; Quincy, 6; Rumsey, 6; Slippery Ford, 4; Snow Mountain (Colusa County), 3; Susanville, 3; Tower House, 5; Ukiah, 7; Vacaville (8 miles west), 7.

Oregon: Ashland, 2; Ferren, 3; Grants Pass, 27; Grizzly Peak (west slope), 5.

THOMOMYS BOTTÆ NAVUS MERRIAM.

RED POCKET GOPHER.

(Pl. IV, fig. 3.)

Thomomys leucodon navus Merriam, Proc. Biol. Soc. Washington, XIV, 112, July 19, 1901.

Type.—Collected at Red Bluff, California, by Clark P. Streator, December 26, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Sacramento Valley, Cal., from Battle Creek, Tehama County, south to Tracy Lake, San Joaquin Valley (fig. 6).

Characters.—Size much smaller than *bottæ;* color lighter; skull relatively shorter and wider, with more projecting incisors, intermediate to some extent between *bottæ* and *leucodon;* mammæ in 4 pairs.

Color.— *Winter pelage:* Upperparts light rusty ochraceous, darker on back, face, and nose; ears blackish; underparts pale buffy or ochraceous; feet whitish. *Summer pelage* (as shown in one July specimen from Marysville Buttes): Slightly brighter and more fulvous above and below than in winter.

Skull.—Short and wide with zygomatic arches widest posteriorly; nasals short, cuneate, emarginate posteriorly; bullæ not large but smoothly rounded. From the skull of *leucodon* it differs in smaller size, narrower interorbital constriction, orange coloration and relatively heavier incisors. *Dentition* light; incisors slender, protruding, and bright orange except the white tips.

Measurements.—Average of 4 topotypes (♂ ad.): Total length, 203; tail vertebræ, 67; hind foot, 27.5. Average of 4 topotypes (♀ ad.): 189, 61, 26.5. *Skull* (of type, ♂ ad.): Basal length, 35; nasals, 13; zygomatic breadth posteriorly, 25; mastoid breadth, 20; alveolar length of upper molar series, 7.

Remarks.—By treating *leucodon* as a subspecies of *bottæ*, it becomes necessary to place *navus* under *bottæ*, with which it connects at one angle as it does with *leucodon* at another. While typical Sacramento Valley specimens of *navus* are strongly marked, others would go with one form as well as with another. Fairfield specimens may with equal propriety be placed with *bottæ, navus,* or *leucodon.* Again, on the east side of the Sacramento Valley, the gradation northward is toward *leucodon,* and southward toward *mewa.* Wheatland and Jackson specimens, though having typical *navus* skulls, are dark and rich in color, approaching *leucodon.*

Specimens examined.—Total number, 178, as follows:

California (Sacramento Valley): Carbondale, 23; Chico, 19; Colusa, 3; Davis, 1; Grafton (Knights Landing), 7; Jackson, 4; Leesville (5 miles west), 2; Marysville Buttes, 38; Mokelumne Hill, 2; Nelson, 1; Oroville (6 miles east), 2; Payne, 1; Red Bluff, 42; Sacramento, 1; St. John, 1; Sites, 8; Tehama, 6; Tracy Lake (San Joaquin Valley), 9; Wheatland, 4; Willows, 1; Winslow, 3.

THOMOMYS BOTTÆ MEWA MERRIAM.

DIGGER PINE POCKET GOPHER.

(Pl. V, fig. 10.)

Thomomys mewa Merriam, Proc. Biol. Soc. Washington, XXI, 146, June 9, 1908.

Type.—Collected at Raymond, Madero County, California, by N. Hollister, June 28, 1904. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Foothill country on east side of San Joaquin Valley, Cal., from Kernville north to Chinese (fig. 6).

Characters.—Smaller than *bottæ*, blacker in winter pelage, more intensely ochraceous-tawny in summer; skull relatively shorter and wider with more rounded bullæ; mammæ in 4 pairs.

Color.—*Winter pelage:* Whole upperparts dull ochraceous-tawny, heavily clouded with glossy black; underparts bright ochraceous; feet whitish; tip of tail whitish or gray. *Summer pelage:* Upperparts rich ochraceous-tawny, darkening to blackish on forehead and around nose and ears; underparts lighter and brighter; nose rufous; feet and tip of tail whitish.

Skull.—Smaller than in *bottæ* and relatively shorter and wider, with fuller, shorter, more rounded bullæ. Size of *navus*, but with less protruding incisors and with zygomatic arches not so conspicuously widened posteriorly; incisors with well-defined inner groove.

Measurements.—Type (♂ ad.): Total length, 225; tail vertebræ, 60; hind foot, 27. Topotype (♀ ad.): 196, 53, 25. *Skull* (of type): Basal length, 37.4; nasals, 13; zygomatic breadth, 24.7; mastoid breadth, 20; alveolar length of upper molar series, 7.

Remarks.—This little, richly colored gopher occupies the Upper Sonoran foothill country from Kernville north to Chinese but farther north grades into *navus*, as shown by Wheatland and Jackson specimens. Others from Merced approach *pascalis* in color but have more nearly the cranial characters of *mewa*. Four females from Kernville are peculiar in abruptly decurved incisors and very rich color. A series of 13 December specimens from Salt Springs are in the fresh black winter pelage with an iridescent purple gloss.

Specimens examined.—Total number, 117, as follows:

California (east side of San Joaquin Valley): Bower Cave (near Mariposa), 3; Camp Badger (Fresno County), 1; Chinese, 2; Coarse Gold, 6; Coulterville, 2; Fresno Flat, 5; Kernville, 4; Merced, 6; Merced Falls, 8; Porterville (8 miles east), 3; Raymond, 58; Salt Springs, 13; Three Rivers, 3; Wawona, 3.

THOMOMYS BOTTÆ MINOR Bailey.

Mendocino Pocket Gopher.

(Pl. IV, fig. 2.)

Thomomys bottæ minor Bailey, Proc. Biol. Soc., Washington, XXVII, 116, July 10, 1914.

Type.—Collected at Fort Bragg, Mendocino County, California, by James H. Gaut, November 30, 1905. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Coast region of California, from Cape Mendocino south to Cazadero (fig. 6).

Characters.—Size smaller than *bottæ;* color slightly darker; skull narrower and slenderer, with especially slender rostrum, and deeply emarginate posterior tip of nasals; mammæ in 4 pairs.

Color.—In November pelage, upperparts dark, rich ochraceous or cinnamon-brown, heavily obscured with black, and in most specimens becoming almost black on nose, face, and around ears; feet white; tail grayish; underparts ochraceous-buff; lips and lining of cheek pouches usually white. Summer pelage but little lighter or brighter.

Skull.—Very slender and rather narrow, with very narrow and deeply emarginate nasals, slender zygomata, rather large and quadrate interparietal, very small and short audital bullæ. *Dentition:* Incisors slender, light colored, and projecting about as in *bottæ.*

Measurements.—Type (♂ ad.): Total length, 226; tail vertebræ, 73; hind foot, 29. Average of 3 adult males: 219, 73, 29. Topotype (♀ young ad.): 187, 58, 24. *Skull* (of type): Basal length, 35; nasals, 13.4; zygomatic breadth, 23; mastoid breadth, 19; interorbital breadth, 4.7; alveolar length of upper molar series, 7.5.

Remarks.—This little, dark, narrow-skulled gopher of the rugged coast strip south of Humboldt Bay can not be included with *bottæ* or *leucodon*, and it is still more distinct from the big, wide-skulled *laticeps.* It closely resembles *nigricans*, but can be distinguished at a glance by its slender, protruding incisors.

Specimens examined.—Total number, 56, as follows:

California: Cape Mendocino, 2; Cazadero (7 miles west), 3; Ferndale, 11; Fort Bragg, 4; Gualala, 9; Gurneyville (1 mile west), 1; Mendocino City, 12; Petrolia, 4; Punta Arena, 7; Rockport, 2; Westport, 1.

THOMOMYS BOTTÆ DIABOLI Grinnell.

Diablo Pocket Gopher.

Thomomys diaboli Grinnell, Univ. of Cal., Publ. Zool. XII, 313, Nov. 21, 1914.

Type.—Collected in Diablo Range, Merced County, California, at Sweeney's ranch, 22 miles south of Los Banos, by C. H. Richardson and H. A. Carr, April 2, 1911. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Inner ridge of the Coast Ranges along west side of the San Joaquin Valley, Cal. (fig. 6).

Characters.—Size small, about as in *navus;* color bright yellowish brown, much as in *angularis,* brighter than summer pelage of *bottæ;* skull a miniature of the *bottæ* skull, with short, wide braincase and projecting incisors.

Color.—*Summer pelage* (March and October specimens): Upperparts bright sayal brown, with but slight darkening of black-tipped hairs; ears and ear patches black; nose dusky; underparts clear, bright ochraceous-tawny; lips and lining of cheek pouches white; tail buffy; feet whitish. *Winter pelage* (as shown in a few not fully typical October specimens from Pacheco Pass and Pacheco Peak): Much darker than in summer, but apparently not so black as in *bottæ.*

Skull.—Similar to that of *bottæ* but smaller and slenderer, with especially slender rostrum and zygomatic arches. *Dentition:* Teeth very light, incisors slender and projecting well beyond tip of nasals, pale yellow or whitish.

Measurements.—Type (♀ young ad.): Total length, 180; tail vertebræ, 60; hind foot, 25. Female topotype: 193, 65, 26.[1] Average adult male from Pacheco: 218, 65, 30; female: 201, 57, 28. *Skull* (of type, ♀ ad.): Basal length, 31; nasals, 10.3; zygomatic breadth, 22; mastoid breadth, 17.9; interorbital breadth, 7; alveolar length of upper molar series, 7.2. Skull of topotype (♂ ad.): 34, 12, 24, 19.3, 6, 7.2. Skull of old male from Pacheco Pass:[2] 37, 12, 25, 20.7, 5.5, 7.5. Skull of old female: 32, 10, 22, 19, 5.5, 7.

Remarks.—This depauperate form of *bottæ* seems to be a product of the hot and arid Upper Sonoran inner ridge of the Coast Ranges along the west side of the San Joaquin Valley, in what Dr. Grinnell calls the "hillside juniper association." It needs no comparison with the robust and massive-skulled *angularis* of the valley along its eastern border, but could easily be confused with intermediates between *leucodon* and *navus* from similar arid ridges north of San Francisco Bay. The skull, however, is more nearly of the true *bottæ* type.

Specimens examined.—Total number, 19, as follows:

California: McKittrick, divide west of (Kern County, 3,000 feet altitude), 1; Pacheco Pass (Santa Clara County), 6; Pacheco Peak (Santa Clara County), 6; Sweeney's Ranch (Diablo Range, Merced County), 6.

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[1] Foot measured dry.

[2] No. 150799, Biological Survey collection.

THOMOMYS BOTTÆ ANGULARIS Merriam.

Los Banos Pocket Gopher

(Pl. III, fig. 7.)

Thomomys angularis Merriam, Proc. Biol. Soc. Washington, XI, 214, July 15, 1897.

Type.—Collected at Los Banos, Merced County, California, by J. Ellis McLellan, January 1, 1894. Type specimen in U. S. Nat. Mus.. Biological Survey collection.

Distribution.—West side of San Joaquin Valley, Cal., from Tracy south to Santiago Spring; also Santa Clara, San Juan, and Salinas Valleys (fig. 6).

Characters.—Size large, hind foot in males averaging 33; ears short and thick; color lighter and brighter than in *bottæ;* skull short, wide, angular, and heavily ridged; mammæ in 4 pairs. inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Rich ochraceous-buff, slightly darkened above with black-tipped hairs; ear patch black; nose and cheeks dusky or brownish; lining of pockets, lips, and sometimes chin, white; feet white; tip of tail nearly or quite naked. *Winter pelage:* Considerably darkened above by excess of black-tipped hairs; slightly paler below—not quite so black as *bottæ.*

Skull.—Males: Relatively shorter, wider, more angular, and more heavily ridged than in *bottæ,* with high sagittal crest in adults; nasals short and widely spatulate; incisors projecting about as in *bottæ.* Females: Much smaller, not ridged or angular; short and wide with arched outline.

Measurements.—Average of 6 topotypes (♂ ad.): Total length, 258; tail vertebræ, 80; hind foot, 33. Average of 4 topotypes (♀ ad.): 209, 66, 28.5. *Skull* (of type, small ♂ ad.): Basal length, 43; nasals, 15.7; zygomatic breadth, 28; mastoid breadth, 24; alveolar length of upper molar series, 8.5. *Skull* (of topotype, larger ♂ ad.):[1] 45, 15, 31, 25, 9.

Remarks.—Specimens from the type locality of *angularis* show strongly marked characters, and considered alone these would indicate that this is a distinct species not closely related to *bottæ;* others, however, from the Santa Clara, San Juan, and Salinas Valleys, while nearest to *angularis,* show a tendency toward *bottæ* in both external and cranial characters, and suggest the probability of intergradation along the sides of these valleys with the smaller, darker, slenderer-skulled *bottæ.*

Specimens examined.—Total number, 101, as follows:

California: Bitterwater, 17; Coalinga, 2; Del Monte (7 miles southeast, in Salinas Valley), 5; Kings City, 1; Los Banos, 54; Palo Alto, 2; Paraiso Spring, 1; Paso Robles, 4; Salinas, 2; San Benito, 3; San Miguelito, 1; Santiago Spring, 2; Tracy (8 miles south), 7.

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[1] No. 93787, U. S. Nat. Mus.

THOMOMYS BOTTÆ PASCALIS MERRIAM.

FRESNO POCKET GOPHER.

(Pl. IV, fig. 1.)

Thomomys angularis pascalis Merriam, Proc. Biol. Soc. Washington, XIV, 111, July 19, 1901

Type.—Collected at Fresno, San Joaquin Valley, California, by Clark P. Streator, March 4, 1892. Type specimen in U. S. Nat. Mus.. Biological Survey collection.

Distribution.—East side of San Joaquin Valley, Cal., from Stockton south to San Emigdio Canyon and Cuyama Valley (fig. 6).

Characters.—Size approximately as in *bottæ;* hind foot averaging 32 mm. in adult males and 28 mm. in females; ear short; color dull ochraceous; skull with broad base and swollen bullæ; mammæ in 4 pairs; inguinal 2–2, pectoral 2–2.

Color.—*Winter pelage:* Upperparts dull ochraceous, slightly darkened on nose and face; ear patch inconspicuous; underparts paler ochraceous; feet white; irregular white spots in many specimens on legs, throat, and belly. *Summer pelage:* Brighter, more fulvous above and below than in winter pelage. The summer pelage is slightly paler than in *angularis* and the winter pelage instead of being darker than the summer, as in *angularis* and *bottæ*, is still paler.

Skull.—Shorter and wider, with larger bullæ and more swollen auditory meatus than in *bottæ;* smaller than in *angularis*, less ridged, with much larger, more rounded bullæ and with narrower angular process of lower jaw, and rarely with sagittal crest, even in old males.

Measurements.—Average of 3 topotypes (♂ ad.): Total length, 219; tail vertebræ, 73; hind foot, 32. Average of 4 females from type locality: 195, 63, 28. *Skull* (of type, ♂ ad.): Basal length, 41; nasals, 16; zygomatic breadth, 28; mastoid breadth, 23; alveolar length of upper molar series, 8.6.

Remarks.—Specimens from Tehachapi, Old Fort Tejon, and San Emigdio Canyon and Mount Pinos, at the south end of the San Joaquin Valley, vary from typical *pascalis* in smaller bullæ and larger auditory meatus, showing probable intergradation with *bottæ* of the adjoining chaparral-covered ranges. Specimens from Cuyama Valley about equally approach *pascalis*, *bottæ*, and *pallescens*. On the north, three specimens from Stockton might almost as well be referred to *angularis*.

Specimens examined.—Total number, 169, as follows:

California (San Joaquin Valley): Alila, 5; Bakersfield, 2; Bakersfield (8 miles northeast), 2; Bodfish, 11; Bodfish (12 miles below), 2; Buena Vista Lake, 6; Buena Vista Slough, 1; Buttonwillow, 12; Cuddy Canyon (near Frazer Mountain), 1; Cuyama Valley, 4; Delano, 1; Earlmart, 2; Fresno, 16; Lane Bridge, 29; Lemoore, 7; Modesto, 5; Mount Pinos (5,500–8,500 feet altitude), 6; Oakdale, 4; Old Fort Tejon, 10; San Emigdio Canyon, 7; Stockton, 3; Tehachapi, 10; Tejon Pass (8 miles west), 3; Tipton, 9; Tulare, 1; Walker Basin, 10.

THOMOMYS BOTTÆ PALLESCENS Rhoads.

Grapeland Pocket Gopher.

(Pl. III, fig. 8.)

Thomomys bottæ pallescens Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1895, 36, Feb. 21, 1895.

Type.—Collected at Grapeland, San Bernardino Valley, California, by R. B. Herron, March 22, 1894. Type specimen in Acad. Nat. Sci. Philadelphia.

Distribution.—San Bernardino Valley, Cal., north to San Fernando (fig. 6).

Characters.—Size of *bottæ*, but paler, and with buffy or whitish belly and less ridged skull; mammæ in four pairs.

Color.—*Summer pelage:* Upperparts dull ochraceous, darker along line of back and around nose; ear patch blackish; underparts pale buffy or soiled whitish. *Winter pelage:* Upperparts heavily clouded with blackish; underparts clear pale buff in sharp contrast.

Skull.—Long and narrow, with narrower braincase and less spreading zygomatic arches than in *bottæ;* lateral ridges parallel, never meeting in old males; incisors decurved more nearly at right angles to axis of skull.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 268; tail vertebræ, 84; hind foot, 32.3. Average of 5 females from type locality: 207, 64, 28. *Skull* (of topotype, ♂ ad.):[1] Basal length, 43; nasals, 16; zygomatic breadth, 27; mastoid breadth, 22; alveolar length of upper molar series, 9.5.

Remarks.—The subspecies *pallescens* is a large pale form of the *bottæ* group, differing from both *pascalis* and *altivallis* in cranial and external characters, but combining some of the characteristics of both with those of *bottæ*. The only typical specimens examined are from the great dry San Bernardino Valley. Those from San Fernando are darker colored and almost as near to *bottæ*, while Santa Paula, Mono Flats, and Little Pine Valley specimens might with almost equal propriety be referred to *pallescens* or *bottæ*.

Specimens examined.—Total number, 68, as follows (fig. 6):

California: Beaumont, 1; Cajon Pass (west slope), 1; Cajon Wash (near San Bernardino), 10; Cold Water Canyon, 1; El Casco, 4; Glendora, 4; Grapeland, 18; Jumpa Mountains, 2; Lytle Creek, 3; Rêche Canyon (4 miles southeast of San Bernardino), 3; San Bernardino, 17; San Fernando, 3; West Riverside, 2.

THOMOMYS BOTTÆ INFRAPALLIDUS Grinnell.

Carrizo Plain Pocket Gopher.

Thomomys infrapallidus Grinnell, Univ. of Cal. Publ. Zool., XII, 314, Nov. 21, 1914.

Type.—Collected on Carrizo Plain (Pimento Ranch, 7 miles south of Simmler) San Luis Obispo County, California, by H. S. Swarth, May 25, 1911. Type specimen in Mus. Vert. Zool., Univ. of California.

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[1] No. 94013, U. S. Nat. Mus.

Distribution.—Carrizo Plain, Cal. (fig. 6).

Characters.—Size large, about as in *bottæ;* color pale, belly buff or whitish; skull similar to that of *bottæ,* but with smaller molars.

Color.—*Summer pelage* (May specimens): Upperparts dull ochraceous-buff, paler than in *angularis* or *pascalis;* nose brownish; ears blackish; underparts pale buffy or whitish (one specimen with almost pure white belly); feet and tail white.

Skull.—Very similar to that of *bottæ* but with conspicuously smaller molar crowns and smaller bullæ. The narrow skull and projecting incisors readily separate this race from *angularis* or *pascalis,* while the projecting incisors and shorter braincase distinguish it from *pallescens.*

Measurements.—Type (♂ ad.): Total length, 248; tail vertebræ, 76; hind foot, 34. Female topotype: 205, 70, 29. *Skull* (of type): Basal length, 40; nasals, 15; zygomatic breadth, 29; mastoid breadth, 23; interorbital breadth, 6.7; alveolar length of upper molar series, 8.

Remarks.—This is evidently a rather local form of the *bottæ* group occupying the hot, arid, alkaline desert valley known as Carrizo Plain. It is paler and more strongly differentiated than is the Cuyama Valley form, in which some of the same characters are less emphasized. These specimens it seems better to identify with *pascalis.* Dr. Grinnell says of the Carrizo Plain, "Faunally and zonally it may be considered very arid, high Lower Sonoran. A sparse prairie vegetation grows on ground that is more or less strongly alkaline over most of the area."[1]

Specimens examined.—Total number, 9, as follows:

California (Carrizo Plain): Painted Rock (5 miles north), 3; Simmler (7 miles south), 6.

THOMOMYS BOTTÆ NIGRICANS Rhoads.

Stephens Pocket Gopher.

(Pl. V, fig. 16.)

Thomomys fulvus nigricans Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1895, 36, Apr. 12, 1895.

Thomomys aphrastus Elliot, Field Columb. Mus., zool. ser., III, 219, June, 1903. *Type* from Santo Tomas, Lower California, 18 miles south of Ensenada at 50–100 feet altitude. Type collected by E. Heller; type specimen in Field Mus. Nat. Hist.

Type.—Collected at Witch Creek, 2,753 feet altitude (7 miles west of Julian), San Diego County, California, by F. Stephens, December 22, 1893. Type specimen in Acad. Nat. Sci. Philadelphia.

Distribution.—Southwestern California and northern Lower California, from the San Jacinto Mountains, Cal., south to Ubar, Lower California (fig. 7).

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[1] Univ. of Cal., Publ. Zool., XII, 314, 1914.

Characters.—Size smaller than *bottæ*, with the same small ears and very similar colors in both winter and summer pelage; skull slenderer, with shorter bullæ and less projecting incisors; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.— *Winter pelage:* Upperparts dark ochraceous-tawny, darkened above by black-tipped hairs; nose, cheeks, and ear patches blackish; underparts lightly washed with rich ochraceous; tip of tail, hind feet, and lining of cheek pouches usually whitish. *Summer pelage:* Lighter and suffused with tawny above and below. *Young,* paler, more buffy above and whitish below.

Skull.—Relatively narrower, slenderer, and less arched than that of *bottæ;* bullæ shorter, more rounded; interparietal more quadrate; external auditory meatus with less expanded rim. *Dentition* lighter; incisors less projecting and more distinctly grooved. It differs from *fulvus*, with which it was originally compared, in less spreading zygomatic arches, slenderer rostrum, and relatively narrower braincase.

Measurements.—Topotype (♂ ad.):[1] Total length, 231; tail, 74; hind foot, 30. Average of 5 typical males from San Jacinto Mountains: 232, 77, 30.2. Average of 5 females: 199, 65, 27.4. *Skull* (of topotype, ♂ ad.):[2] Basal length, 34.5; nasals, 13.5; zygomatic breadth, 23; mastoid breadth, 18; interorbital breadth, 6.5; alveolar length of upper molar series, 7.5.

Remarks.—From *bottæ*, *nigricans* differs in lighter, slenderer skull; more abruptly decurved and more distinctly grooved incisors; lighter dentition; and numerous details of cranial and external characters; but scarcely if at all in color. It is much smaller and darker than *pallescens* with which it intergrades at Elsinore and Wildomar, while Twin Oak specimens are clearly intermediate between *nigricans* and *bottæ*.

In a series of 18 specimens from Santo Tomas, Lower California, I find no characters by which to recognize *Thomomys aphrastus* as even subspecifically different from *nigricans*. A series of 32 specimens of *alticolus* from the Victoria Mountains, farther south on the peninsula, are scarcely distinguishable from *nigricans* in external characters, but in cranial characters tend toward *anitæ*.

Specimens examined.—Total number, 401, as follows:

California (southern): Ballena, 1; Campo (San Diego County, at 2,500 feet altitude), 8; Cuyamaca Mountains, 16; Dulzura, 14; Escondido, 3; Foster, 5; Fullers Mill, 1; Grapevine Spring, 1; Hemet Valley, 5; Jacumba, 11; Jamul Creek, 3; Julian, 15; Kenworthy, 2; La Puerta, 24; Mountain Spring, 1; Pine Mountains, 1; Poway, 1; Rose Canyon, 1; San Jacinto Mountains (south end at 5,000 to 8,000 feet), 21; Santa Rosa Peak, 1; Santa Ysabel, 15; Schains Ranch, 4; Strawberry Valley (in central part of San Jacinto range at 6,000 feet), 24; Thomas Mountain, 1; Tia Juana, 2; Tia Juana River (mouth), 1 Warners Pass, 7; Witch Creek (San Diego County at 2,750 feet), 53.

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[1] No. 148685, U. S. Nat. Mus.

[2] No. 148688, U. S. Nat. Mus.

Lower California: Aguaji de las Fresas, 2; Ensenada, 6; Ensenada (canyon 20 miles east), 1; Fresnal, 1; Hanson Laguna, 11; La Grulla (at 7,000 feet altitude), 13; La Huerta (Hanson Laguna Mountains), 1; Mattomi, 1; Milquatay Valley, 2; Nachoguero Valley, 4; Parral, 5; Pinon (west slope San Pedro Martir Mountains), 3; Rancho la Progresa, 5; Rancho Santo Tomas (12 miles south of La Grulla), 3; Rancho Viejo (15 miles south of Alamos), 5; Rosarito, 2; San Antonio, 3; San Francisquito, 2; San Pedro Martir Mountains, 11; San Quintin, 14; San Telmo, 18; San Ysidro Ranch, 4; Santa Eulalia, 7; Santa Rosa, 1; Santo Tomas, 18; Socorro, 2; Tecate Valley, 2; Trinidad Valley (northwest base San Pedro Martir Mountains), 2; Vallecitos, 6; Yubay, 4 (not typical).

THOMOMYS BOTTÆ PUERTÆ GRINNELL.

LA PUERTA POCKET GOPHER.

Thomomys nigricans puertæ Grinnell, Univ. of Cal., Publ. Zool., XII, 315, Nov. 21, 1914.

Type.—Collected at La Puerta (Mason's Ranch, 5 miles west of Vallecitos, at the lower end of La Puerta Valley), San Diego County, California, by F. Stephens, May 31, 1909. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—La Puerta and San Felipe Valleys, Cal. (fig. 6).

Characters.—In size, proportions, and cranial characters, very similar to *nigricans*, but much paler in both summer and winter pelage; considerably brighter than *cabezonæ*.

Color.—*Summer pelage:* Upperparts pale ochraceous-tawny, becoming darker along median line of back; ears and postauricular spot black; nose and face brownish or dusky; underparts pale or bright cinnamon; feet and tail buffy or soiled whitish. *Winter pelage:* Duller and more grayish, fading to pinkish- or vinaceous-salmon in bright-colored individuals.

Skull.—Not readily distinguishable from that of *nigricans* from the surrounding chaparral slopes.

Measurements.—Type (♂ young ad.): Total length, 203; tail vertebræ, 80; hind foot, 28. *Skull* (of type): Basal length, 32; nasals, 12; zygomatic breadth, 21.2; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 7.

Remarks.—The series of 43 specimens in the Museum of Vertebrate Zoology labeled La Puerta were collected by F. Stephens, and Grinnell says, "According to his field notebook, the majority were caught in cultivated land on Mason's Ranch, which is located at the lower end of La Puerta Valley. Others, however, were taken on surrounding hillsides."[1] The 43 specimens divide readily into 21 of the present pale form and 22 of the typical dark-colored *nigricans*. These I assume represent a pale desert form from the valley bottom where creosote bush, mesquite, and cactus indicate extreme arid Lower Sonoran conditions; and typical *nigricans* from the Upper Sonoran chaparral-covered slopes along the sides of the valley. In a valley so narrow the two forms undoubtedly intermingle to some extent along the boundaries of their respective habitats, but most of the specimens show no intermediate characters.

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[1] Univ. of Cal. Pub. Zool., XII, 315, Nov. 21, 1914.

Specimens examined.—Total number, 23, as follows:

California: La Puerta, 21; San Felipe Valley, 2.

THOMOMYS BOTTÆ ANITÆ ALLEN.

CAPE SAN LUCAS POCKET GOPHER.

(Pl. V, fig. 11.)

Thomomys fulvus anitæ Allen, Bul. Am. Mus. Nat. Hist., X, 146–147, 1898.

Type.—Collected at Santa Anita, Lower California, by Dane Coolidge, May 28, 1896. Type specimen in British Museum.

Distribution.—Southern part of Lower California from Santana south to Cape San Lucas (fig. 7).

Characters.—Slightly smaller than *bottæ;* larger than *nigricans;* thin haired, bright tawny all over at all seasons, but little darker above than below; skull heavy, with abruptly decurved incisors; mammæ in 4 pairs.

Color.—For most of the year bright tawny, nearly concolor; underparts slightly lighter because thinly haired; feet and tail half naked. In new autumn pelage, apparently from September to December, slightly duller, more grayish. *Young,* slightly paler, with whitish belly.

Skull.—Relatively heavier than in *bottæ* or *nigricans,* with short, heavy rostrum, abruptly decurved incisors, short thick pterygoids, and full rounded bullæ.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 243; tail vertebræ, 78; hind foot, 32.8. Average of 5 topotypes (♀ ad.): 208, 67, 30. *Skull* (of topotype, ♂ ad.):[1] Basal length, 40; nasals, 14; zygomatic breadth, 25.5; mastoid breadth, 21; interorbital breadth, 6.5; alveolar length of upper molar series, 8.8.

Remarks.—Evidently intergradation is complete through local forms up the peninsula through *nigricans* to *bottæ.* The subspecies *anitæ* strikingly resembles *fulvus,* however, and but for its direct connection with *bottæ* I should not change Dr. Allen's original arrangement, making it a subspecies of *fulvus.* The *bottæ* and *fulvus* groups are widely separated geographically. Externally *anitæ* is not easily distinguishable from *sinaloæ,* just across the gulf, but the skulls are different.

Specimens examined.—Total number, 99, as follows:

Lower California: Cape San Lucas, 11; La Paz, 12; Las Palmas, 1; Matancita, 6; Miraflores, 5; Rosarito, 20; San Jorge, 5; San Jose del Cabo, 10; Santana, 8; Santa Anita, 16; Tres Pachitas, 1; Triunfo, 4.

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[1] No. 146831, U. S. Nat. Mus.

THOMOMYS BOTTÆ ALTICOLUS ALLEN.

SIERRA LAGUNA POCKET GOPHER.

(Pl. IV, fig. 8.)

Thomomys fulvus alticolus Allen, Bul. Am. Mus. Nat. Hist., XII, 13, Apr. 4, 1899.

Type.—Collected at Sierra Laguna, Lower California, Mexico (altitude 7,000 feet), by Dane Coolidge, July 10, 1896. Type specimen in British Museum.

Distribution.—Victoria Mountains, southern Lower California (fig. 7).

Characters.—Size and proportions of *anitæ* or slightly smaller; well furred and dark colored; skull slightly slenderer than in *anitæ*, but very similar; mammæ in 4 pairs.

Color.— *Winter pelage:* Upperparts dark ochraceous or snuff brown, heavily clouded with dusky, usually darkest along median line of back; nose, ear patch, and cheeks blackish; underparts washed with bright ochraceous-tawny; lining of cheek pouches, feet, and tip of tail usually whitish. *Summer pelage:* Clear ochraceous, scarcely darker above than below, or varying to almost black in specimens with a strong tendency toward dichromatism.

Skull.—Slightly slenderer than that of *anitæ*, less slender than in typical *nigricans*, and with larger bullæ, wider occiput, and wide premaxillæ.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 225; tail vertebræ, 72; hind foot, 30. Average of 5 topotypes (♀ ad.): 203, 67, 28. *Skull* (of topotype, ♂ ad.): Basal length, 38; nasals, 13.5; zygomatic breadth, 24; mastoid breadth, 20; interorbital breadth, 6.5; alveolar length of upper molar series, 8.5.

Remarks.—This is a dark, mountain form of *anitæ* from the higher zone of nut pines and oaks. The two forms are so closely related that the skulls are practically indistinguishable, but the skins greatly differ in color. Compared with *nigricans*, the skins are scarcely distinguishable, but the skulls are strikingly different.

Specimens examined.—Total number, 52, as follows:

Lower California (southern): La Laguna, 20; Victoria Mountains, 32.

THOMOMYS BOTTÆ RUSSEOLUS NELSON & GOLDMAN.

SAN ANGEL POCKET GOPHER.

(Pl. IV, fig. 9.)

Thomomys bottæ russeolus Nelson & Goldman, Proc. Biol. Soc. Washington, XXII, 25, Mar. 10, 1909.

Type.—Collected at San Angel, Lower California, at 100 feet above sea level, by E. W. Nelson and E. A. Goldman, October 15, 1905. Type specimen in U. S. Nat. Mus., Biological Survey collection.[1]

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[1] No. 146836, U. S. Nat. Mus.

Distribution.—Known only from type locality (fig. 7).

Characters.—Smaller than *anitæ* or *nigricans*, with tiny ears, slender skull, thin hair, and pale buffy coloration.

Color.—About as in *perpallidus*, or slightly brighter. October specimens: Upperparts varying from pale to bright buffy; nose grayish; small ear patch dusky; underparts pale buffy, becoming whitish on throat; feet and tail thinly clothed with whitish hairs.

Skull.—Light and slender, with narrow braincase, short narrow posteriorly truncate nasals, wide premaxillæ, slender pterygoids, full rounded bullæ, and narrowly constricted shaft of basioccipital. *Dentition:* Incisors abruptly decurved at right angles to axis of skull.

Measurements.—Type (♂ young ad.): Total length, 208; tail vertebræ, 73; hind foot (dry), 30. Topotype (♂ young ad.): 225, 82, 27 (dry). Topotype (♀ im.): 88, 60, 27 (dry). *Skull* (of type): Basal length, 35.5; nasals, 12.7; zygomatic breadth, approximately 24; mastoid breadth, 19; interorbital breadth, 6; alveolar length of upper molar series, 7.5.

Remarks.—While in color practically identical with *magdalenæ* and very similar to *perpallidus*, this desert form differs in cranial characters from *magdalenæ* and *anitæ* in light slender skull, slender pterygoids, large rounded bullæ, and narrow basioccipital; and from *perpallidus* in narrow braincase, wider premaxillæ, and uniformly truncate nasals. The characters strongly suggest a little slender-skulled form of *perpallidus*. The type specimens are from an oasis in a sandy desert where they were apparently isolated, but specimens from Rosarito on the north and San Jorge on the south apparently intergrade with *anitæ*.

One specimen from San Jorge and two from Rosarito might be thrown with *russeolus* (though the majority from the same places are nearer *anitæ*), and on this account this form was made a subspecies of *bottæ* rather than of *perpallidus*.

Specimens examined.—Four, from type locality.

THOMOMYS MAGDALENÆ NELSON & GOLDMAN.

MAGDALENA POCKET GOPHER.

(Pl. V, fig. 12.)

Thomomys magdalenæ Nelson & Goldman, Proc. Biol. Soc. Washington, XXII, 24, Mar. 10, 1909.

Type.—Collected at Magdalena Island, near west coast of Lower California, by E. W. Nelson and E. A. Goldman, December 3, 1905. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Magdalena Island, Lower California (fig. 7).

Characters.—Larger than *anitæ*, with heavy, angular skull; color paler; hair thin.

Color.—Type (collected December 3): Upperparts bright buffy orange; underparts, feet, and tail pale buffy or whitish; a scarcely perceptible dusky ear spot.

Skull.—Old male: Very heavy and angular, with narrow braincase, short heavy rostrum, abruptly decurved incisors, angular and anteriorly spreading zygomatic arches, deep lateral pits of palate, prominent and revolutely margined pterygoids.

Measurements.—Type: Total length, 255; tail vertebræ, 87; hind foot, 36. *Skull*: Basal length, 41.5; nasals, 15; zygomatic breadth, 29; mastoid breadth, 23; interorbital breadth, 6; alveolar length of upper molar series, 9.

Remarks.—The type and only specimen of *magdalenæ* is a fine old male from this barren, sandy island off the coast of Lower California. While having strongly marked affinities with *anitæ* of the mainland, the single specimen is so different as to indicate a well-marked insular species. The general characters are those of *anitæ* greatly accentuated. It evidently belongs in the *bottæ* group and is not more different from that species than is *angularis*, just over the ridge from the type region of *bottæ*.

Specimen examined.—One, the type.

THOMOMYS ALTIVALLIS RHOADS.

SAN BERNARDINO MOUNTAIN POCKET GOPHER.

(Pl. III, fig. 9.)

Thomomys altivallis Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1895, 34, Feb. 21, 1895.

Type.—Collected on San Bernardino Mountains, California, (altitude 5,000 feet), by R. B. Herron, August 10, 1894. Type specimen in Acad. Nat. Sci. Philadelphia.

Distribution.—San Bernardino Mountains, Cal. (fig. 6).

Characters.—Size large, hind foot in males averaging 34, in females 30; ears short; color dull and dark; skull long, well ridged, with heavy dentition and sloping posterior base of zygoma; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2 (one individual with 2 pairs of abdominal also).

Color.—Paler than in *bottæ*, slightly duller and darker than in *pallescens;* upperparts dull ochraceous with trace of darker dorsal stripe; ear patch, nose, and cheeks blackish; underparts, feet, and most of tail buffy or soiled whitish. Pelage apparently brighter ochraceous in summer than in winter, but only traces of much-worn winter pelage are shown in the specimens examined.

Skull.—Longer and less spreading than in *bottæ*, less sharply ridged, with less inflated auditory meatus, and heavier rostrum; larger than in *pallescens*, with heavier rostrum and less sharply constricted posterior base of zygomatic arch.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 269; tail vertebræ, 78; hind foot, 34. Average of 5 topotypes (♀ ad.): 224, 64, 30. *Skull* (of topotype, old ♂):[1] Basal length, 46; nasals, 17; zygomatic breadth, 30; mastoid breadth, 24; alveolar length of upper molar series, 10.

Remarks.—*Thomomys altivallis* apparently has its nearest relative in *pallescens*, which stands intermediate in characters and geographic position between it and *bottæ*. It is probably a robust, mountain form of the *bottæ* group occupying the higher levels of the San Bernardino Mountains. The exact type locality is unknown other than as 5,000 feet altitude in the San Bernardino Mountains. Herron, who collected it, is no longer living, and S. N. Rhoads, who described the species, has no further information as to its location. The type specimen, however, is of the large, high-mountain form, agreeing with the large series from Bluff Lake and vicinity.

Specimens examined.—Total number, 155, as follows:

California (at various altitudes from 2,700 to 9,200 feet in the San Bernardino Mountains): Bear Lake, Bear Valley, Bluff Lake, Doble, Dry Lake, Fish Creek, Santa Ana River, Seven Oaks, Sugarloaf, Waterman Canyon, and Fawnskin Park.

Thomomys alpinus Group.

THOMOMYS ALPINUS ALPINUS MERRIAM.

MOUNT WHITNEY POCKET GOPHER.

(Pl. V, fig. 13.)

Thomomys alpinus Merriam, Proc. Biol. Soc. Washington, XI, 216, 1897.

Type.—Collected on Big Cottonwood Meadows (8 miles southeast of Mount Whitney), at 10,000 feet altitude in the Sierra Nevada, California, by B. H. Dutcher, August 6, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Southern part of the Sierra Nevada, Cal., at altitudes between 6,000 and 11,000 feet, from Mount Whitney south to Siretta Meadows (fig. 6).

Characters.—Size large; hind foot about 30 mm. in both males and females; sexes very similar; ears large and conspicuous; colors dull and dark; skull not ridged or angular; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Dull dark ochraceous (much as in *bottæ*), becoming blackish along middle of back, paler on belly; nose blackish; throat white; feet and distal two-thirds of tail whitish. One immature specimen is paler, more ochraceous above and buffy below. *Winter pelage* (long and faded on rump and sides in July specimens): Dull dark clay color.

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[1] No. 89968, U. S. Nat. Mus.

Skull.—Compared with that of *bottæ* the skull is light and slender, without conspicuous ridges or angles in old age; the incisors are decurved; interorbital region wide and flat; interparietal quadrate; auditory meatus smaller; zygomatic arches less spreading; and nasals conspicuously widened anteriorly. From that of *fulvus* the skull differs less in size and proportions, but has relatively heavier dentition; smaller bullæ; narrower basioccipital; larger, more quadrate interparietal; and narrower posterior part of nasals.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 222; tail vertebræ, 61; hind foot, 30.3. Average of 5 topotypes (♀ ad.): 222, 63, 30. *Skull* (of type, ♂ ad.): Basal length, 36; nasals, 14; zygomatic breadth, 25; mastoid breadth, 19; interorbital breadth, 6.6; alveolar length of upper molar series, 8.

Remarks.—Typical *alpinus* seems not readily to fall into any of the larger groups of species. From *fulvus* it differs more than from *bottæ*, and from the little slender-skulled *monticola* still more widely, except in the large ears. From the *perpallidus* group it differs in long, narrow skull, large molars, and in so many other details as to indicate no close connection. From *nigricans* it differs less in either color or cranial characters than from *bottæ* but shows larger molars, more spreading nasals, greatest width of zygomata posterior instead of anterior to middle, and other distinctions. For the present it may well be retained as the center of a group to which *awahnee* and *neglectus* belong, and possibly also *jacinteus* and *martirensis*.

Specimens examined.—Total number, 158, as follows:

California (southern High Sierra): Big Cottonwood Meadows (10,000 feet altitude), 30; Cottonwood Creek (9,500 feet), 2; Cottonwood Lakes (11,000 feet), 25; Jackass Meadows (7,000 feet), 12; Jordan Hot Springs (6,700 feet), 8; Menache Meadows (8,000 feet), 17; Olanche Peak (9,000–9,750 feet), 6; Ramshaw Meadows, 3; Red Rock Meadows (9,000 feet), 2; Siretta Meadows (9,000 feet), 1; Trout Creek (6,000 feet), 19; Whitney Meadows (9,000 feet), 33.

THOMOMYS ALPINUS AWAHNEE Merriam.

Yosemite Pocket Gopher.

(Pl. V, fig. 9.)

Thomomys alpinus awahnee Merriam, Proc. Biol. Soc. Washington, XXI, 146, June 9, 1908.

Type.—Collected in Yosemite Valley, Mariposa County, California, (at 4,000 feet altitude in bottom of valley, near the Sentinel Hotel), by N. Hollister, June 14, 1904. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Western slopes of the Sierra Nevada, Cal., from Sequoia, Tuolumne County, south to Tehachapi Peak (fig. 6).

Characters.—Size small; colors dull and dark; skull slender and narrow, with short rostrum and abruptly decurved incisors; mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts dull dark ochraceous; underparts varying from pale buffy to ochraceous; belly irregularly marked and spotted with white in all Yosemite specimens; feet and distal half of tail whitish. *Winter pelage:* Darker, more dusky ochraceous.

Skull.—But little arched; not ridged or angular; rostrum short and incisors abruptly decurved; interorbital region wide and flat; interparietal usually short and wide; bullæ small and well rounded.

Measurements.—Topotype (♂ ad.): Total length, 220; tail vertebræ, 75; hind foot, 27. Type (♀ ad.): 194, 54, 26. *Skull* (of type): Basal length, 32; nasals, 12; zygomatic breadth, 21; mastoid breadth, 17; alveolar length of upper molar series, 7. Skull of male from Merced River: 34, 12.4, 22, 18.5, 7.5.

Remarks.—This form is not represented by a good series of adult male specimens from any one locality, but specimens from scattered localities throughout the Transition Zone, from Crockers (north of the Yosemite Valley) south to the vicinity of Mineral King, show the same general characters. Those from near Mineral King are somewhat darker than specimens from the Yosemite Valley and suggest an approach to *alpinus,* while those in the Yosemite are paler and have irregular white markings. Others from Kern River Lakes and Piute Mountain and one from Tehachapi Peak are also referred to it, but they show considerable variation.

Specimens examined.—Total number, 116, as follows:

California (southern and western slopes of the Sierra Nevada): Alta Meadows (Giant National Forest), 2; Connell Meadow (Tulare County, 7,500 feet altitude), 11; Halstead Meadows (in Sequoia National Park, 7,000 feet), 5; Horse Corral Meadows (in Sequoia National Park, 8,000 feet), 2; Huckleberry (near Giant National Forest), 1; Kaweah River (east fork, 5,600 and 8,900 feet), 2; Kern River Lakes, 2; Mineral King, 8; Piute Mountain (5,000 feet?), 31; Sequoia (Crockers), 6; South Fork Merced River (4,000 feet), 1; Taylor Meadow (Tulare County, 7,000 feet), 25; Tehachapi Peak, 1; Wawona, 2; Yosemite Valley, 17.

THOMOMYS NEGLECTUS Bailey.

San Gabriel Pocket Gopher.

(Pl. V, fig. 15.)

Thomomys neglectus Bailey, Proc. Biol. Soc. Washington, XXVII, 117, July 10, 1914.

Type.—Collected on San Antonio Peak (Bear Flat Meadows at 6,400 feet altitude) in the San Gabriel Mountains, California, by James H. Gaut, July 23, 1905. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 6).

Characters.—Size medium; colors grizzled with a dark mixture of ochraceous and black; skull long and narrow, with almost straight dorsal outline; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—July pelage, in which 3 molts are shown: Upperparts dark gray produced by a heavy mixture of black-tipped hairs over dull ochraceous; nose, face, and ear patch blackish; tail gray; feet whitish; underparts dull buffy.

Skull.—Adult males: Long and narrow, with narrow braincase; nasals and rostrum long and straight; zygomatic arches slender; bullæ small and especially short and rounded; interparietal small and triangular.

Measurements.—Type (♂ ad.): Total length, 229; tail vertebræ, 77; hind foot, 32 (measured dry). Topotype (♂ ad.): 206, 64, 31. Female topotype: 211, 65, 31. *Skull* (of type): Basal length, 37; nasals, 14.5; zygomatic breadth, 24; mastoid breadth, 19.5; interorbital breadth, 6; alveolar length of upper molar series, 7.5.

Remarks.—Externally this species differs very little from *altivallis* of the San Bernardino Mountains, but the skulls show such striking differences that the two forms can not be considered closely related. Neither does the present form show any characters of *pallescens* on the south or of *perpes* on the north slopes of its range, but appears to approach *alpinus* and *awahnee* of the southern Sierra Nevada. Its actual range and real relationship present an interesting problem still to be worked out.

Specimens examined.—Three, from type locality.

THOMOMYS JACINTEUS GRINNELL & SWARTH.

SAN JACINTO POCKET GOPHER.

(Pl. V, fig. 14.)

Thomomys jacinteus Grinnell & Swarth, Proc. Cal. Acad. Sci., 4th ser., IV, 153–160, Dec. 30, 1914.

Type.—Collected on San Jacinto Mountains (Round Valley, at 9,000 feet altitude), California, by H. S. Swarth, September 15, 1914. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Upper slopes of San Jacinto Mountains, Cal. (fig. 6).

Characters.—Size medium, slightly larger than *nigricans*, much smaller than *altivallis*, and about the size of *martirensis* and *neglectus;* colors dark; skull long and narrow with relatively straight dorsal outline; mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts dark rich ochraceous, darkened with black-tipped hairs, darkest along median line of back; nose dusky; ears and ear patches black; underparts brighter ochraceous without black-tipped hairs; lining of cheek pouches and usually lips white; base of tail brownish; tip of tail and feet whitish. *Winter pelage:* More clouded by black above.

Skull.—Long, low, and narrow, with especially long narrow braincase; zygomatic arches widest at anterior angle and narrowed posteriorly with the narrowing of the braincase; nasals truncate posteriorly, generally long and narrowly cuneate, but in the type rather wide and spatulate; interparietal rather small, quadrate, narrowing with age; pterygoids long and low and nearly parallel; interpterygoid fossa not narrowly V-shaped. *Dentition* relatively heavy; incisors curved abruptly downward and not extending much beyond tip of nasals and premaxillæ.

Measurements.—Type (♂ ad.): Total length, 240; tail vertebræ, 82; hind foot, 32. Topotype (♂ ad.): 234, 80, 31.5. Topotype (♀ ad.): 232, 76, 29. *Skull* (of type): Basal length, 40; nasals, 14.5; zygomatic breadth, 24.7; mastoid breadth, 20; interorbital breadth, 6; alveolar length of upper molar series, 8.8.

Remarks.—At first I was reluctant to separate this high-mountain form from *nigricans* by skull characters alone, as the skins are indistinguishable, but the series of specimens recently collected in Round Valley in the San Jacinto Mountains (at 9,000 feet altitude) by H. S. Swarth show that the skull characters are well marked and constant. The series of 8 males and 5 females from the type locality, now before me, have the long, low, narrow, straight skulls of *cabezonæ* with the same peculiar pterygoids. They differ from *cabezonæ* in larger size, heavier dentition, and much darker color, but show a decided relationship with that species. The resemblance to *nigricans* may be entirely superficial just as it is with *fulvus*, the three forms being very similar in coloration while evidently quite distinct. A close relationship with *neglectus* is indicated by the general type of skull, but that form is much more extreme in its characters. From *martirensis* the present form differs in a rather straight instead of well-arched outline of skull. The two other high-mountain species with which comparison is suggested are *altivallis* and *alpinus* from similar altitudes in the San Bernardino Mountains and the Sierra Nevada. Of these, *altivallis* is at once eliminated on account of its larger size and its broad, well-arched, and massive skull, protruding incisors, and narrowly contracted pterygoids. *Thomomys alpinus*, while so similar in general size and appearance as strongly to suggest relationship, has a very different type of skull; shorter, wider, and more arched zygomata (widest posteriorly); and too many detailed differences to admit of close relationship with the present form.

Specimens examined.—Total number, 25, as follows:

California (higher levels of San Jacinto Mountains): Round Valley (9,000 feet altitude) 8; San Jacinto Peak (10,200 feet), 1; Tahquitz Valley (8,000 feet), 13; Tamarack Valley (9,400 feet), 2; uncertain locality along the trail (8,500 feet), 1.

THOMOMYS MARTIRENSIS Allen.

San Pedro Martir Pocket Gopher.

Thomomys fulvus martirensis Allen, Bul. Am. Mus. Nat. Hist., X, 147, 1898.

Type.—Collected on San Pedro Martir Mountains (at 8,200 feet altitude), Lower California, by A. W. Anthony and E. C. Thurber, in May, 1893. Type specimen in Am. Mus. Nat. Hist.

Distribution.—San Pedro Martir Mountains, Lower California (fig. 7).

Characters.—Size considerably larger than *nigricans;* skull longer; colors grayer in both winter and summer pelage.

Color.— *Winter pelage:* Very long and dark gray, not so black as in *nigricans;* underparts buffy gray; tail and feet grayish; lining of cheek pouches white; no white on chin and throat. *Summer pelage:* Dull fulvous, not so intense as in *nigricans* or *fulvus.*

Skull.—Adult males: Very long and narrow, with especially narrow zygomatic arches and long, narrow braincase, in these characters apparently exceeding *neglectus* and *jacinteus;* dorsal outline arched, and rostrum depressed about as in *nigricans.*

Measurements.—Type (♂ ad.): Total length, 248; tail vertebræ, 67; hind foot (measured dry), 31. The tail measurement of type is short; other specimens have longer tails, 8 females averaging 70. *Skull:* Basal length, 41.6; nasals, 15; zygomatic breadth, 25; mastoid breadth, 21; interorbital breadth, 6.5; alveolar length of upper molar series, 8.

Remarks.—This is evidently a very local form occupying some high valley or the crest of the range, since other series from not far distant in the same range and only a little lower down, as at Vallecitos at 8,000 feet altitude, La Grulla at 7,000 feet, and Santo Tomas at 6,000 feet, are typical of *nigricans.* In December, 1914, A. W. Anthony wrote me that the type series of specimens was collected at La Grulla Meadows at 8,200 feet altitude in the San Pedro Martir Mountains, but the series of specimens collected by Nelson and Goldman at La Grulla (7,000 feet) are *nigricans.*

As the mountains rise to 10,200 feet, this may be a mountain-top form of considerable range. The true relationship of these high-mountain forms from *alpinus* to *martirensis* is not very clear and will not be until definite field study shows whether they merge into lower forms or are distinct and isolated.

Specimens examined.—Fourteen, from type locality.

Thomomys perpallidus Group.

THOMOMYS PERPALLIDUS PERPALLIDUS MERRIAM.

PALM SPRINGS POCKET GOPHER.

(Pl. V, fig. 2.)

Thomomys talpoides perpallidus Merriam, Science, VIII, 588, Dec. 24, 1886.

Type.—Collected at Palm Springs (Agua Caliente) Riverside County, California (at sea level on the edge of the Colorado Desert, 6 miles south of Palm Springs Station), by F. Stephens, March or April, 1886.[1] Type specimens in U. S. Nat. Mus., Merriam collection.

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[1] In the original description no type was designated by number, but Dr. Merriam refers to several skins collected by F. Stephens in March and April on the Colorado Desert. In the Merriam collection are 4 skins and skulls labeled in accord with this statement, Nos. [illegible]♂, [illegible]♂, [illegible]♂, and [illegible]♀. Of these No. [illegible] is the only fully adult male and should have been made the type.

Distribution.—Colorado Desert, southern California, from Whitewater south to Salton Sea (fig. 6).

Characters.—Size medium, hind foot 31 mm. in adult male topotype; tail long; ears small; color pale buffy gray or whitish; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Summer pelage:* Upperparts buffy or cream color; ear patches dusky; nose and cheeks grayish brown; underparts, feet, and tail whitish, thinly haired. *Winter pelage:* Paler than in summer, upperparts creamy or whitish. *Young*, buffy gray.

Skull.—Rather light and slender, without conspicuous ridges or angles; zygomatic arches slender and parallel; nasals rather short, cuneate, truncate, or slightly emarginate at posterior tips; interparietal small and irregularly triangular, oval, or quadrate; bullæ short but full and rounded. *Dentition* rather light; incisors abruptly decurved.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 241; tail vertebræ, 84; hind foot, 31.5. Average of 4 topotypes (♀ ad.): 215, 78, 30. *Skull* (of topotype, ♂ ad.): Basal length, 37: nasals, 15; zygomatic breadth, 26; mastoid breadth, 21; interorbital breadth, 6.4; alveolar length of upper molar series, 7.7.

Remarks.—This very pale, desert species occupies the scattered moist oases in the hottest and driest of our deserts. Apparently its range is not continuous, as no gopher hills are to be found over wide areas of bare hot desert. The numerous colonies are to some extent isolated, and differences too slight for even subspecific recognition mark the specimens from almost every locality, but the main characters hold true over a wide area. Specimens from Carrizo Creek grade toward the more robust form *albatus* of the Colorado River bottoms on the California side, west of Yuma. A small series from Salt Creek, north of the Salton Sea, seem to go better with *perpallidus* than with any of the other three forms to which they might almost as well be referred. Direct intergradation is shown with *perpes* and through it with *griseus* and *aureus*.

The *aureus* group as heretofore considered now becomes the *perpallidus* group and includes *perpallidus*, *albatus*, *chrysonotus*, *perpes*, *canus*, *aureus*, *apache*, *cabezonæ*, *operarius*, and probably also *latirostris*, *cervinus*, and *sinaloæ*.

Specimens examined.—Total number, 68, as follows:

California: Agua Dulce, 1; Baregas Spring (8 miles east), 5; Colorado Desert (no specific locality), 5; Fish Spring, 2; Mission Creek, 1; Palm Springs, 35; Salt Creek (Riverside County), 8; Salton Sea (west side), 1; Whitewater, 10.

THOMOMYS PERPALLIDUS ALBATUS Grinnell.

White Pocket Gopher.

(Pl. V, fig. 1.)

Thomomys albatus Grinnell, Univ. of Cal., Publ. Zool., X, 172, 1912.

Type.—Collected on west side of Colorado River at old Hanlon Ranch near Pilot Knob, Imperial County, California, by J. Dixon, May 7, 1910. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Southeastern California and northeastern Lower California from Carrizo Creek south to Gardner's Lagoon, Salton River (fig. 6).

Characters.—Size considerably larger than *perpallidus;* color lighter; ears small; tail long; feet stout; mammæ in 4 pairs.

Color.—*Summer pelage* (May and June): Upperparts pale buff or cream color; nose and ears grayish brown; underparts white or creamy with little or no plumbeous base to fur; feet and tail almost naked but with scattered short white hairs. *Winter pelage*: Practically as in summer, but with more evident plumbeous base to fur on belly. *Young:* Less buffy, more grayish white.

Skull.—In old males rather heavy, ridged, and angular, widest at anterior angle of zygomata; rostrum short and heavy; incisors not so abruptly decurved as in *perpallidus;* bullæ full and rounded; occiput rather sloping, not so abruptly truncate as in *aureus* and *perpes*.

Measurements.—Type (♂ ad.): Total length, 272; tail vertebræ, 100; hind foot, 35. Topotype (♂ ad.): 264, 91, 34. Topotype (♀ ad.): 229, 79, 34. *Skull* (of type): Basal length, 41.5; nasals, 15; zygomatic breadth, 28; mastoid breadth, 22; interorbital breadth, 6.8, alveolar length of upper molar series, 8.5. Skull of old female: 38, 13.5, 25, 21, 6.5, 7.7.

Remarks.—This is a robust gopher very close to *perpallidus* in color, but in size and skull characters close to *aureus*. It occupies the moist, white, river sand of the flats where there is an abundant food supply. Specimens from Carrizo Creek are not typical but nearer *albatus* than *perpallidus*. Others from Baregas Spring and west of the Salton Sea are nearer *perpallidus*.

Specimens examined.—Total number, 72, as follows:

California: Carrizo Creek, 18; Colorado River bottoms opposite Yuma, 37; Salt Creek (Imperial County), 11; Salton Sea (Imperial County), 6.

Lower California: Salton River (Gardners Lagoon), 1.

THOMOMYS PERPALLIDUS CHRYSONOTUS GRINNELL.

YELLOW-BACKED POCKET GOPHER.

Thomomys chrysonotus Grinnell, Univ. of Cal., Publ. Zool., X, 174, 1912.

Type.—Collected at Ehrenburg, Arizona, (on dry mesa back from river bottoms), by F. Stephens, March 27, 1910. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Southwestern Arizona and northwestern Sonora, from Ehrenberg south to near mouth of Colorado River, and east to Quitobaquito (figs. 7 and 8).

Characters.—Size smaller than *perpallidus*; ears minute; skull shorter, and bullæ more globose; color about the same; mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts bright to pale buff; ears brown or dusky at tips; postauricular patch generally inconspicuous; nose brownish; underparts and well up on sides whitish with pale plumbeous base of hair; feet and tail thinly clothed with short white hairs. *Winter pelage:* More grayish, fading to very pale buff in early spring.

Skull.—Short and wide; rostrum relatively shorter and wider than in *perpallidus*; bullæ fuller and more rounded; upper incisors more abruptly decurved; premaxillæ in type ending approximately even with posterior tip of nasals, but in the majority of specimens extending well back of nasals; interparietal small and nearly triangular; pterygoids short, thick, low, and wide apart.

Measurements.—Type (♂ ad.): Total length, 217; tail vertebræ, 73; hind foot, 30. Adult female from Yuma, Ariz.: 203, 65, 27. *Skull* (of type): Basal length, 33.5; nasals, 13.5; zygomatic breadth, 23; mastoid breadth, 19; interorbital breadth, 7; alveolar length of upper molar series, 8.

Remarks.—This seems to be a dry-mesa form more nearly agreeing with typical *perpallidus* than with the more robust *albatus* of the moist bottoms just across the Colorado River. Originally I identified the type for Dr. Grinnell as *perpallidus*, but since that time he has collected a fine series of topotypes of *perpallidus* at Palm Springs, which show better diagnostic characters than do the series in the National Museum collection, and fully warrant the separation of the form ranging in the dry hot desert east of the Colorado River in southwestern Arizona and northwestern Sonora.

Specimens examined.—Total number, 25, as follows:

Arizona: Ehrenburg, 1; Monument No. 204, east side of Colorado River, 1; Quitobaquito, 2; Tacna, 1; Tule Wells (in Tule Mountains near Sonora line), 5; Yuma, 12.

Sonora: Cienega Well, 2; Mesa on east side of Colorado River, 20 miles below the Arizona line, 1.

THOMOMYS PERPALLIDUS PERPES MERRIAM.

LONE PINE POCKET GOPHER.

(Pl. V, fig. 3.)

Thomomys aureus perpes Merriam, Proc. Biol. Soc. Washington, XIV, 111, July 19, 1901.

Thomomys scapterus Elliot, Field Columb. Mus., zool. ser. III, 248, 1903. Type collected by E. Heller, in Hanopee Canyon, Panamint Mountains, California. Type specimen in Field Mus. Nat. Hist.

Type.—Collected at Lone Pine, Owens Valley, Inyo County, California, by E. W. Nelson, December 23, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Upper Sonoran desert valleys and mountain slopes of eastern California, from near head of Owens Valley south to Hesperia and Morongo Valley, into the valley of Kern River, and east to the Providence Mountains, Cal., and the Grapevine Mountains, Nev. (fig. 6).

Characters.—About the size of *perpallidus* or slightly smaller, with shorter tail, larger ears, slenderer skull, and brighter, stronger color; smaller and grayer than *aureus;* mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts bright buffy ochraceous; nose grayish brown; ear patch dusky; underparts buffy or creamy white; throat often pure white; feet and tail thinly covered with short silvery hairs. *Winter pelage:* Upperparts duller, darker, and more grayish buff. *Young,* very similar to adults.

Skull.—Slender and light with rarely a trace of lateral ridges; well arched; narrower and slenderer than in *perpallidus*, with especially slenderer rostrum; palate slightly more arched than in *perpallidus*, much less arched than in *aureus;* interparietal generally quadrate; bullæ full and rounded; nasals slightly emarginate or occasionally truncate. *Dentition* rather light; upper incisors decurved at right angles to axis of skull.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 215; tail vertebræ, 66; hind foot, 28.7. Average of 5 topotypes (♀ ad.): 210, 67, 28.5. *Skull* (of type): Basal length, 33; nasals, 12.3; zygomatic breadth, 22; mastoid breadth, 18.6; interorbital breadth, 6.5; alveolar length of upper molar series, 7.5.

Remarks.—This small gray form of the *perpallidus* group occupies Upper Sonoran desert valleys and slopes of eastern California. In parts of the Mohave Desert where it extends down into Lower Sonoran valleys it becomes slightly larger and paler than normal and might almost as well be placed with *aureus;* while in the foothills of the Sierra Nevada, San Gabriel, and San Bernardino Mountains it becomes slightly darker than the typical form and may grade into *awahnee.* It does not occur in Death Valley or Panamint Valley, and gives place to *operarius* in the bottom of Owens Valley, and to *aureus* in Ash Meadows and the Amargosa Valley. Its connection with *perpallidus* on the south has been fully established by recent collections, so that both *perpes* and *aureus* must stand as subspecies of this earliest-described form of the desert group. *Thomomys scapterus* of Elliot proves to be typical of *perpes*.

Specimens examined.—Total number, 344, as follows:

California: Ash Creek (west of Owens Lake), 1; Barstow, 16; Benton Station, 4; Bishop, 1; Cactus Flat, 1; Carroll Creek, 1; Copper City, 1; Coso, 19; Cushenbury Spring, 2; Daggett, 2; Fairmont, 1; Granite Spring, 1; Grapevine Ranch, 3; Haway Meadows (south of Owens Lake), 2; Hesperia, 1; Independence, 13; Independence Creek, 2; Inyo Mountains, 1; Isabelle, 6; Kern River (South Fork, near Onyx), 17; Lone Pine, 64; Lone Willow Spring, 7; Ludlow, 2; Maturango Spring, 1; Mohave River, 4; Morongo Pass, 1; Mount Waterman (north slope in San Gabriel Mountains), 1; New York Mountain (in Providence Range), 1; Orogrande, 16; Panamint Mountains (Johnson Canyon, Perognathus Flat, Coal Kilns, Hanopee Canyon, head of Willow Creek, and Cottonwood Creek), 23; Resting Spring, 24; Tuttle Creek, 5; Twelve Mile Spring, 1; Victorville, 26; Walker Pass, 28; Warrens Ranch (in Morongo Valley), 1; Warrens Well (east of Morongo Valley), 2; Weldon, 37; White Mountains (pass between Deep Spring and Owens Valley), 1.

Nevada: Grapevine Mountains, 3; Thorps Mill, 1.

THOMOMYS PERPALLIDUS CANUS BAILEY.

GRAY POCKET GOPHER.

(Pl. V, fig. 6.)

Thomomys canus Bailey, Proc. Biol. Soc. Washington, XXIII, 79, May 4, 1910.

Type.—Collected at Deep Hole, at north end of Smoke Creek Desert, Nevada, by Clark P. Streator, May 14, 1896. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Valleys of western and central Nevada, from Flowing Springs, western Humboldt County, south to Cloverdale and Monitor Valley, west to Honey Lake, Cal. (fig. 5).

Characters.—Considerably larger than *perpallidus*, with larger ears and shorter tail; size of *aureus* or a little larger; hind foot 30–33 mm.; colors buffy gray; skull wide, palate flat, not arched between molar series; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—Upperparts pale buffy gray with dusky ear patch and brownish nose; underparts, feet, and tail whitish. The remnant of a more yellowish pelage on the rump of a topotype collected May 16 would indicate a darker winter pelage, while an old female collected at Amadee July 24 is coming into a still more ashen gray pelage.

Skull.—Much heavier and wider than that of *perpallidus;* like that of *aureus* but lower and wider with flat instead of arched palate; interparietal larger and more quadrate; bullæ slightly larger; anterior points of frontals less acute; lateral pits of palate deeper.

Measurements.—Type (♂ ad.): Total length, 242; tail vertebræ, 64; hind foot, 33. Average of 3 topotypes (♀ ad.): 216, 66, 30.3. *Skull* (of type): Basal length, 41; nasals, 15; zygomatic breadth, 28; mastoid breadth, 23; alveolar length of upper molar series, 9.

Remarks.—In color *canus* closely resembles the gray phase of its near neighbor *nevadensis*, but shows no relationship with it in cranial characters, while it does agree closely with the *perpallidus* group. It inhabits moist fertile soil of alkaline valleys, with many interruptions in range and some variation in characters. Specimens from Cloverdale, Peavine, and Monitor Valley, Nev., could almost as well be referred to *aureus*.

Specimens examined.—Total number, 43, as follows:

California: Amedee (Lassen County), 1; Fort Sage, 1.

Nevada: Carson River (Ragtown), 2; Carson Sink, 2; Cloverdale, 7; Deep Hole, 5; Fallon, 3; Flowing Spring, 1; Granite Creek, 2; Monitor Valley, 1; Peavine, 4; Pyramid Lake (south end), 9; Smoke Creek. 4; Wadsworth, 1.

THOMOMYS PERPALLIDUS AUREUS ALLEN.

YELLOW POCKET GOPHER.

(Pl. II, fig. 4; Pl. V, fig. 5.)

Thomomys aureus Allen, Bul. Am. Mus. Nat. Hist., V. 49, Apr. 28, 1893.

Type.—Collected at Bluff, San Juan County, Utah, by Charles P. Rowley, May 12, 1892. Type specimen in Am. Mus. Nat. Hist.

Distribution.—Desert region of southern Nevada, southern Utah, western Colorado, central and northwestern New Mexico, and northern and western Arizona (fig. 8).

Characters.—Size rather large; hind foot 29–32 mm.; ear relatively small; color golden buff; skull heavy, long, high, and narrow, with palate greatly arched between the molar series; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.— *Winter pelage:* Upperparts beautiful orange-buff, varying to paler and darker shades and sometimes with a wash of dusky along the back; ear patch and nose blackish in the darker and slightly dusky in the lighter individuals; underparts, feet, and tail creamy white. *Summer pelage:* Slightly darker. *Young*, more grayish.

Skull.—Long and narrow, with light lateral ridges parallel or sometimes nearly meeting in a sagittal crest in extreme old age; outline of palate strongly arched; bullæ full and rounded; interpterygoid fossa normally U-shaped with a central point or spicule extending from median ridge of palate; nasals cuneate and usually truncate posteriorly. *Dentition* heavy; upper incisors abruptly decurved at right angles to skull.

Measurements.—Average of 5 old male topotypes: Total length, 240; tail vertebræ, 73; hind foot, 31. Average of 5 old females: 224, 78, 30. *Skull* (of topotype, ♂ ad.):[1] Basal length, 42; nasals,

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[1] No. 57162, U. S. Nat. Mus.

17; zygomatic breadth, 27; mastoid breadth, 22; interorbital breadth, 7: alveolar length of upper molar series, 9.

Remarks.—The subspecies *aureus* is an Upper and Lower Sonoran desert form occupying the bottoms of open sandy valleys, many of which are separated by mountainous or rough country in which the subspecies does not occur. In almost every valley slight variations of characters can be detected, but in none do they become so marked as to require recognition by name. In eastern California this form grades into the smaller *perpes*, which is mainly Upper Sonoran in range, while *aureus* occupies the Lower Sonoran valleys. On the south it evidently grades into *albatus* along the Colorado River bottoms, and thence into *perpallidus* of the Colorado Desert. Two specimens from Wickenburg, Ariz., are referred with some hesitation to *aureus*. Series of specimens from Manti and the Pine Valley Mountains, Utah, are by no means typical but may be called *aureus* rather than *perpes*. In New Mexico the subspecies reappears in the Rio Grande Valley from Bernalillo to San Marcial, and while growing darker to the southward is perfectly typical of *aureus* at Albuquerque.

Specimens examined.—Total number, 306, as follows:

Arizona: Chin Lee, 2; Jacobs Pool, 4; Keams Canyon, 6; Parker, 16; Wickenburg, 2.

California: Amargosa River (near Nevada line), 3.

Colorado: Ashbaugh Ranch, 1; Coventry, 8; Grand Junction, 1; Los Pinos, 1; Mesa Verde, 1.

Nevada: Ash Meadows, 51; Charleston Mountains (east base), 4; Colorado River (head of Black Canyon), 1; Oasis Valley, 3; Pahranagat Valley, 1; Pahrump Valley, 23; St. Thomas, 5; Vegas Valley, 10.

New Mexico: Acoma, 2; Albuquerque, 4; Bear Spring Mountains, 6; Belen, 6; Bernalillo, 4; Chusca Mountains (west slope), 1; El Vado (Chama River Valley), 1; Fruitland, 4; Gallina (Chama River Valley), 1; Gallup, 2; Juan Tofoya, 2; Laguna, 4; Riley, 4; San Augustine Plain (12 miles northwest of Monica Spring), 6; San Marcial, 5; Shiprock, 2; Socorro, 13; Wingate, 1.

Utah: Bluff (San Juan County), 48; Hanksville, 6; Hebron, 1; Henry Mountains, 3; Kanab, 4; Manti, 13; Mountain Meadows, 2; Pine Valley, 4; Pine Valley Mountains, 7; St. George, 5; Santa Clara, 2.

THOMOMYS PERPALLIDUS APACHE BAILEY.

JICARILLA POCKET GOPHER.

(Pl. IV, fig. 6.)

Thomomys apache Bailey, Proc. Biol. Soc. Washington, XXIII, 79, May 4, 1910.

Type.—Collected at Lake La Jara (7,500 feet altitude) on the Jicarilla Apache Indian Reservation, N. Mex., by James H. Gaut, September 19, 1904. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Transition Zone in northeastern Arizona, northwestern New Mexico, and southwestern Colorado (fig. 7).

Characters.—Size large, hind foot 33–34 mm.; color dark; hind feet and tip of tail conspicuously white; mammæ in 4 pairs.

Color.—Upper and under parts nearly uniform dull sooty gray slightly washed with dull ochraceous; back with an ill-defined stripe of blackish from tip of nose to base of tail; basal half to three-quarters of tail brownish or blackish, the rest abruptly white; hind feet white; lips usually and chin rarely white. *Young:* One half-grown individual is lighter, more buffy, with white belly.

Skull.—Similar in form and general characters to that of *aureus;* bullæ full and rounded; pterygoids U-shaped, with spicule point of palatal ridge; nasals normally slightly emarginate with doubly rounded posterior tips, instead of normally truncate as in *aureus,* or widely emarginate as in *fulvus. Dentition:* Upper incisors white-tipped and decurved at nearly right angles to axis of skull.

Measurements.—Type (♂ ad.): Total length, 229; tail vertebræ, 74; hind foot, 34. Topotype (♀ ad.): 229, 74, 33. *Skull* (of type): Basal length, 41; nasals, 14; zygomatic breadth, 28; mastoid breadth, 23; alveolar length of upper molar series, 8.5.

Remarks.—This is a large, dark form of the *perpallidus* group with conspicuous markings, but with cranial characters close to those of *aureus.* It seems to be a dark local Transition Zone form of the yellow *aureus* of the surrounding valleys.

Specimens examined.—Total number, 36, as follows:

Arizona: Canyon de Chelly (7 miles above mouth), 1; Fort Defiance (sawmill 12 miles northwest), 2.

Colorado: Arboles, 1; Bayfield, 1.

New Mexico: Boulder Lake, 4;[1] Chama River (near Gallina), 1 (not typical); Chusca Mountains (around lakes at top of range, 8,000–9,000 feet altitude), 13; Lake La Jara, 2;[1] Stinking Lakes, 11.[1]

THOMOMYS CABEZONÆ MERRIAM.

CABEZON POCKET GOPHER.

(Pl. V, fig. 8.)

Thomomys cabezonæ Merriam, Proc. Biol. Soc. Washington, XIV, 110, July 19, 1901.

Type.—Collected at Cabezon, San Gorgonio Pass, California, by Clark P. Streator, June 3, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—San Gorgonio Pass, southern California, south to Cabezon (fig. 6).

Characters.—Size medium, hind foot 30 mm.; ears rather large; color dull ochraceous; skull long and narrow.

Color.—*Summer pelage:* Upperparts dull ochraceous, varying from buffy ochraceous to dull brownish; ear patch black; nose and lips dusky or plumbeous; underparts creamy white to buffy or salmon. In 8 of 10 topotypes collected in June, a paler, more buffy gray pelage (probably winter) is disappearing on the rump.

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[1] On the Jicarilla Apache Indian Reservation in northern New Mexico.

Skull.—Long, narrow, and slender, with nearly parallel lateral ridges; zygomata parallel or slightly wider anteriorly; nasals long and narrow; interparietal rectangular or oval, wider than long in immature skulls; pterygoids long, low, and thin, with rounded symphysis.

Measurements.—Average of 7 male topotypes: Total length, 221; tail vertebræ, 79; hind foot, 30. Average of 3 female topotypes: 208, 71, 28.7. *Skull* (of type): Basal length, 35; nasals, 14.5; zygomatic breadth, 23; mastoid breadth, 18; alveolar length of upper molar series, 7.

Remarks.—*Thomomys cabezonæ* seems to be a local form not closely connected with surrounding species. From *perpallidus*, its nearest neighbor on the east, and *pallescens* on the west, it is sharply differentiated. In general appearance it most nearly resembles *perpes*, from which it differs strikingly in large ears and in many cranial characters. Two specimens from Whitewater show an overlapping of range with *perpallidus*, but Gaut reports *cabezonæ* in irrigated fields, and *perpallidus* in the sagebrush. A single specimen of *nigrescens* from 2,500 feet altitude near Banning, and 7 specimens of *cabezonæ*, show a meeting or overlapping of ranges along the edge of the valley. The narrow braincase suggests relationship with *jacinteus*, and with *neglectus* of which it may be a pale valley form.

Specimens examined.—Total number, 55, as follows:

California (southern): Banning, 12; Cabezon, 27; Schains Ranch (4,500 feet altitude), 4; Snow Creek (near Whitewater), 2; Whitewater, 10.

THOMOMYS OPERARIUS Merriam.

Owens Lake Pocket Gopher.

(Pl. V, fig. 4.)

Thomomys operarius Merriam, Proc. Biol. Soc. Washington, XI, 215, July 15, 1897.

Type.—Collected at Keeler, California, on east side of Owens Lake, at 3,600 feet altitude, by E. W. Nelson, November 29, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 6).

Characters.—Size medium, hind foot 30 mm.; color rich buff; skull short and wide; mammæ in 4 pairs.

Color.—Upperparts rich buff or pale ochraceous; ear patch gray or plumbeous; underparts, feet, and tail creamy white. *Young*, more grayish.

Skull.—Short and wide with short, heavy rostrum; zygomata abruptly spreading; upper incisors sharply decurved or slightly incurved; maxillaries short and heavy.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 223; tail vertebræ, 69; hind foot, 30.6. Average of 5 females: 217, 66, 29.6. *Skull* (of type): Basal length, 38; nasals, 13.5; zygomatic breadth, 26.7; mastoid breadth, 21.5; interorbital breadth, 7; alveolar length of upper molar series, 8.5.

Remarks.—*Thomomys operarius* seems to be a very local form, quite distinct from *perpes*, by which its range is closely surrounded, but more nearly resembling *albatus* in short rostrum and heavy skull, and *aureus* in color. While clearly of the *perpallidus* group, it seems not to have direct connection with any of the forms and may well stand as described, a full species. It is confined to the sandy alkaline soil along the east side of Owens Lake.

Specimens examined.—Seventy-nine, from type locality.

THOMOMYS LATIROSTRIS MERRIAM.

PAINTED DESERT POCKET GOPHER.

(Pl. V, fig. 7.)

Thomomys latirostris Merriam, Proc. Biol. Soc. Washington, XIV, 107, July 19, 1901.

Type.—Collected at Little Colorado River, Painted Desert, Arizona (at Tanners Crossing, northeast of San Francisco Mountain), by C. Hart Merriam and Vernon Bailey, September 22, 1899. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Painted Desert, Ariz. (fig. 8).

Characters.—Size medium, hind foot 33 mm.; skull flattened; rostrum short and broad; ears very small; color orange-buff, much as in *aureus*.

Color.—Upperparts bright buffy yellow or pale orange-buff, without trace of black-tipped hairs; ears dusky; nose grayish brown; underparts, feet, and tail white, with a tinge of sulphur yellow stain on belly of type. *Young*, slightly less yellow, more buffy.

Skull.—Narrow and flat, with wide, flat rostrum; nasals narrow in the middle, spreading anteriorly; premaxillæ unusually wide at base of rostrum; incisors abruptly decurved at right angles to axis of skull; interparietal broadly pentagonal; bullæ small, about as in *fulvus;* basioccipital wide, flat, and keeled.

Measurements.—Type (♂ ad.): Total length, 232; tail vertebræ, 79; hind foot, 33. *Skull* (of type): Basal length, 39; nasals, 14; zygomatic breadth, 26; mastoid breadth, 21; alveolar length of upper molar series, 8.

Remarks.—While unique in characters, *latirostris* can best be placed in the group with *aureus* (*perpallidus*), with which it agrees in abruptly decurved incisors and U-shaped pterygoids. It is evidently an isolated form of restricted range. The type specimen was caught in the sand dunes in the Painted Desert along the Little Colorado River at Tanners Crossing, between Black Tank and Moencopie. It is a very old male in thin summer pelage, a worn and faded portion of which is disappearing over the posterior half of the body, while a new, bright coat is replacing it over the anterior half. An immature female taken at Tuba, August 16, 1909, by Clarence Birdseye, is the only other known specimen. The distinguishing characters of the species are maintained in this young specimen, which disproves the idea that the type was abnormal. Two skulls of immature females without skins, from Winslow, do not possess characters sufficiently well marked for satisfactory determination, but are provisionally referred to *latirostris*. Apparently this is a Painted Desert form somewhat related to *aureus*.

Specimens examined.—Total number, 4, as follows:

Arizona: Painted Desert, 1; Tuba, 1; Winslow, 2.

THOMOMYS CERVINUS Allen.

Phœnix Pocket Gopher; Fawn-Colored Pocket Gopher.

(Pl. VI, fig. 2.)

Thomomys cervinus Allen, Bul. Am. Mus. Nat. Hist., VII, 203, June 29, 1895.

Type.—Collected at Phœnix, Arizona, by J. Diefenbach, October 20, 1894. Type specimen in Am. Mus. Nat. Hist.

Distribution.—Upper Gila Valley, Ariz. (figs. 7 and 8).

Characters.—Size large, hind foot 33–36 mm.; color pale fawn; skull heavy, ridged, and angular; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts pale fawn, with conspicuously blackish ear patch; nose and cheeks brown or blackish; underparts, feet, and tail a still paler shade of fawn; lining of cheek pouches white. *Young*, with whitish bellies.

Skull.—Long and narrow, as in *aureus;* palate only slightly arched; bullæ large and truncate instead of smoothly rounded anteriorly; pterygoids variable, narrowly constricted or wide apart, with thickened margins, and often inclosing a postpalatal spicule.

Measurements.—Average of 3 topotypes (♂ ad.): Total length, 253; tail vertebræ, 84; hind foot, 34.6. Average of 5 topotypes (♀ ad.): 245, 77, 34. *Skull* (of topotype, ♂ ad.):[1] Basal length, 42; nasals, 15.5; zygomatic breadth, 28; mastoid breadth, 20.5; interorbital breadth, 6.5; alveolar length of upper molar series, 8.

Remarks.—This is evidently a large form of the *perpallidus* group, occupying the Gila Valley. From *albatus* of the Colorado River valley it differs in darker color and longer, slenderer skull and rostrum. It also suggests relationship with the *fulvus* group through *toltecus* of the valleys farther east.

Specimens examined.—Total number, 19, as follows:

Arizona: Phœnix, 16; Sacaton, 1; Tempe, 2.

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[1] No. 23707, U. S. Nat. Mus.

THOMOMYS SINALOÆ Merriam.

Sinaloa Pocket Gopher.

(Pl. IV, fig. 7.)

Thomomys sinaloæ Merriam, Proc. Biol. Soc. Washington, XIV, 108, July 19, 1901.

Type.—Collected at Altata, Sinaloa, Mexico (altitude 10 feet above sea level), by E. A. Goldman, March 28, 1899. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Western Sonora and Sinaloa, from Hermosillo south to Albata (fig. 7).

Characters.—Size rather large, hind foot 30–32 mm.; tail long; pelage thin; color bright tawny; skull heavy, wide, and angular; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—Upperparts bright tawny or dull chestnut with a trace of dusky along back; underparts plain light tawny; nose grayish brown: feet and tail half-naked, half-covered with buffy hairs. *Young,* paler, more buffy. Summer and winter colors not very different.

Skull.—Heavy, wide, and angular; rostrum wide; nasals short and normally truncate posteriorly; zygomata abruptly spreading; bullæ full and rounded; basioccipital narrow between bullæ. *Dentition* heavy; incisors abruptly decurved.

Measurements.—Type (♂ ad.): Total length, 233; tail vertebræ, 73; hind foot, 31. Average of 3 topotypes (♂ ad.): 228, 75, 31.5. Average of 3 adult females: 214, 73, 31.3. *Skull* (of type): Basal length, 39.5; nasals, 14.5; zygomatic breadth, 28.3; mastoid breadth, 22; interorbital breadth, 6.2; alveolar length of upper molar series, 8.2.

Remarks.—Despite fulvous coloration the closest affinities of this form appear to be with the *perpallidus* group. From its nearest relative, *cervinus*, it differs in thin pelage, darker coloration, and short wide skull. Two small females from Magdalena, Sonora, are not typical and can only provisionally be referred to this species.

Specimens examined.—Total number, 22; as follows:

Sinaloa: Altata, 6.
Sonora: Camoa, 11; Hermosillo, 2; Magdalena, 2; Ortiz, 1.

Thomomys fulvus Group.

THOMOMYS FULVUS FULVUS (Woodhouse).

Fulvous Pocket Gopher.

(Pl. VI, fig. 1.)

Geomys fulvus Woodhouse, Proc. Acad. Nat. Sci., Philadelphia, VI, 201, 1852.
Thomomys fulvus Baird, Mamm. N. Am., 402, 1857.

Type.—Collected on San Francisco Mountain, Arizona, by Dr. S. W. Woodhouse, October, 1851. Type specimen in U. S. Nat. Mus.

Distribution.—Transition Zone in northern and central Arizona from the Trumbull Mountains to the White Mountains; east in New

Mexico to Sierra Grande, and the White and Guadalupe Mountains; north to Fisher Peak, southeastern Colorado (fig. 7).

Characters.—Size medium; hind foot 28–30 mm.; color dark tawny or dull chestnut; ears and claws medium; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts clear dark tawny or light chestnut, often dusky or blackish along back; ear patch, nose, and cheeks dusky or blackish; underparts lighter; chin, lining of cheek pouches, and feet usually white or whitish; tail tawny or dusky above, grayish below. *Winter pelage:* Duller darker tawny, more uniformly dusky above. *Young* very similar to adults.

Skull.—Heavier and relatively wider than in the *fuscus* or *fossor* groups; lighter and slenderer than in *perpallidus* or *aureus.* Lateral ridges slightly developed and approximately parallel at all ages; nasals broadly emarginate posteriorly; bullæ medium; basioccipital broadly triangular; pterygoid fossa normally V-shaped. *Dentition:* Incisors not projecting beyond tip of nasals; distinctly grooved.

Measurements.—Old male topotype: Total length, 231; tail vertebræ, 74; hind foot, 30. Average of 5 male topotypes: 219, 70, 30. Average of 5 female topotypes: 209, 66, 29.2. *Skull* (of topotype, ♂ ad.):[1] Basal length, 36; nasals, 15; zygomatic breadth, 24; mastoid breadth, 19; interorbital breadth, 6; alveolar length of upper molar series, 8.

Remarks.—The typical subspecies of *Thomomys fulvus* seems to occur only in the Transition Zone, above which it rarely extends and below which it extends mainly in modified forms, several of which have been separated. The name *fulvus* stands not only for a species with its six subspecies, but for the center of a widely distributed group, including *mearnsi*, *baileyi*, and *lachuguilla.* Its relationship with the *bottæ* group of the west coast is genetically close but geographically the two are widely separated. If connected with the *perpallidus* group it is through *toltecus* and *cervinus*, but this connection seems doubtful and by no means close.

Specimens examined.—Total number, 305, as follows:

Arizona: Aubrey (10 miles south of Pine Spring, 6,000 feet altitude), 2; Beaver Creek (near Fort Verde), 1; Bill Williams Mountain, 2; Blue (Greenlee County, 6,000 feet), 2; Bradshaw City, 17; Flagstaff, 2; Fort Verde, 5; Fort Whipple, 2; Fossil Creek, 3; Grand Canyon (Canyon Spring), 1; Little Spring (18 miles northwest of Flagstaff), 1; Pine Spring (5 miles north, 7,000 feet), 1; Prescott, 7; Prieto Plateau (south end Blue Range, Greenlee County, 7,500–9,000 feet), 6; San Francisco Mountain, 20; Springerville (7,000 feet), 29; Trumbull Mountains, 3; White Mountains, 3.

Colorado: Fisher Peak, 1.

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[1] No. 24506, U. S. Nat. Mus.

New Mexico: Burro Mountains, 2; Capitan Mountains, 36; Chloride (10 miles east), 1; Cliff, 1; Cloudcroft, 7; Cloudcroft (10 miles north), 1; Coppermines, 1; Copperton, 6; Corona, 6; Carasal (Bernalillo County), 3; Datil Mountains, 7; Fairview, 1; Folsom, 2; Fort Wingate, 2; Gallina Mountains, 1; Gila, 5; Glenwood, 1; Guadalupe Mountains, 6; Halls Peak, 7; Head of Mimbres, 2; Hoskins Ranch (Colfax County), 2; Jicarilla Mountains, 5; Kingston (about 4 miles west, 9,500 feet altitude), 2; Long Canyon (3 miles north of Catskill), 1; Luna, 3; Luna (6 miles southwest, 7,000 feet), 5; Magdalena Mountains (Copper Canyon, 8,200 feet), 1; Magdalena Mountains (Water Canyon, 6,500 feet), 1; Manzano Mountains, 12; Mimbres River, 1; Mogollon Mountains, 7; Mora (10 miles south), 4; Mount Capitan (east base), 1; Pecos, 2; Pleasanton, 3; Quemado (10 miles southwest), 2; Raton Range (near Folsom), 3; Rio Alamosa (15 miles north of Ojo Caliente, 6,900 feet), 1; Ruidosa, 7; San Andres Mountains, 6; San Mateo Mountains (Monica Canyon, 8,000 feet), 2; San Pedro, 2; Sierra Grande, 4; Silver City, 12; Fort Stanton, 3; Fort Union, 1; Zuni Mountains, 5; Zuni River, 1.

THOMOMYS FULVUS PERVAGUS Merriam.

Espanola Pocket Gopher.

(Pl. IV, fig. 5.)

Thomomys aureus pervagus Merriam, Proc. Biol. Soc. Washington, XIV, 110, 1901.

Type.—Collected at Espanola, New Mexico, by J. Alden Loring, January 4, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Upper Rio Grande and San Luis Valleys in northern New Mexico and southern Colorado (fig. 8).

Characters.—Size large, hind foot 31–33 mm.; color lighter than in *fulvus;* skull longer and heavier; mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts plain bright tawny; nose, cheeks, and ear patch blackish; underparts paler tawny; feet whitish; tail dusky above, usually to tip. *Winter pelage:* Slightly duller above and below.

Skull.—As in *fulvus*, but longer, narrower, and with less-spreading zygomatic arches, and slightly larger audital bullæ; differing from *aureus* in less arched palate, emarginate nasals, and V-shaped pterygoids.

Measurements.—Type (♂ ad.): Total length, 244; tail vertebræ, 76; hind foot, 31. Average of 4 topotypes (♂ ad.): 239, 73, 32.3. Average of 5 females: 224, 68, 31.4. *Skull* (of type): Basal length, 42; nasals, 15.5; zygomatic breadth, 27; mastoid breadth, 21; alveolar length of upper molar series, 8.

Remarks.—In characters *pervagus* stands so nearly between *fulvus* and *aureus* as to suggest that it forms a connecting link between the two groups, but in a large number of specimens, collected since the species was described, the affinities are uniformly with *fulvus* instead of *aureus*. It is evidently a paler, more robust, Upper Sonoran valley form of *fulvus* inhabiting the upper Rio Grande and San Luis Valleys.

Specimens examined.—Total number, 50, as follows:

Colorado: Antonito, 8; Conejos River (6 miles west of Antonito), 2; Gardiner, 2; Salida, 9.

New Mexico: Abiquiu, 1; Arroyo Hondo, 4; Chama River Canyon (above Abiquiu), 1; Espanola, 8; Fort Burgwyn, 5; Questa, 4; Rinconada, 2; Santa Clara Canyon, 2; Santa Fe, 1;[1] Santa Fe (10 miles north), 1.

THOMOMYS FULVUS DESERTORUM MERRIAM.

DESERT POCKET GOPHER.

(Pl. VI, fig. 6.)

Thomomys desertorum Merriam, Proc. Biol. Soc. Washington, XIV, 114, July 19, 1901.

Type.—Collected at Mud Spring (10 miles southwest of Mineral Park, southern end of Detrital Valley), Arizona, at about 3,400 feet altitude in Lower Sonoran Zone, by Vernon Bailey, February 21, 1889. Type specimen in U. S. Nat. Mus., Merriam collection.

Distribution.—Detrital and Big Sandy Valleys, northwestern Arizona; east in the Grand Canyon to Prospect Valley (figs. 7 and 8).

Characters.—Size small, hind foot 26 mm.; color bright tawny; skull small, light, and smooth, with abruptly decurved incisors; sexes very similar; mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts rich orange-tawny, or orange-cinnamon, lighter and brighter than in *fulvus;* ear patch, nose, and cheeks dusky; underparts creamy white to light cinnamon; feet and tail soiled whitish or buffy. *Winter pelage:* Duller and more yellowish; upperparts bright cinnamon; underparts whitish to buffy ochraceous.

Skull.—Small and light, smoothly rounded, not ridged or angular; bullæ small, but full and rounded, not flattened and angular as in *fulvus,* nor large and prominent, as in *aureus;* basioccipital, as in *fulvus,* wide with sharp keel. *Dentition:* Incisors bent downward at right angles to axis of skull.

Measurements.—Type (♂ ad.): Total length, 200; tail vertebræ, 68; hind foot, 26. Average of 5 male topotypes: 195, 63, 26. Average of 4 female topotypes: 190, 60, 25.5 *Skull* (of type): Basal length, 33; nasals, 12; zygomatic breadth, 22; mastoid breadth, 17.5; alveolar length of upper molar series, 6.5.

Remarks.—The color of this little gopher in summer pelage suggests relationship to *fulvus,* but its cranial characters are so strongly marked that it was originally described as a species. It may, however, probably be considered a depauperate Lower Sonoran desert form of the *fulvus* group, with a range corresponding to that of the creosote bush in the Detrital and Big Sandy Valleys, and extending well up into the Grand Canyon.

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[1] In the mammal collection of the Academy of Natural Sciences of Philadelphia is a mounted skin without skull (No. 145) of a typical *Thomomys pervagus.* It is labeled "Columbia River," but the label has been copied from the catalogue where originally no locality was indicated, and the locality of the preceding specimen has been given to it. This is evidently the specimen referred to (Proc. Acad. Nat. Sci. Phila., VI, 1852, p. 53, Pl. LXIV) as *Geomys rufescens,* donated by Col. Geo. A. McCall. McCall's specimens apparently were not labeled, but this collection of 70 mammals and bird skins was said to be from California and Oregon. As *pervagus* is neither a California nor an Oregon form, the specimen in question probably came from Santa Fe, N. Mex., where McCall was previously stationed.

Specimens examined.—Total number, 34, as follows:

> **Arizona:** Big Sandy Creek (at 2,000 feet altitude), 7; Dolans Spring, 7;[1] Grand Canyon (at 4,500 feet in lower end of Prospect Valley on Hualpai Indian Reservation), 4; Little Meadows (in Sacramento Valley), 2; Mineral Park, 3;[1] Mud Spring, 8;[1] Willow Spring, 3.[1]

THOMOMYS FULVUS INTERMEDIUS MEARNS.

MOUNTAIN-TOP POCKET GOPHER.

(Pl. VI, fig. 5.)

Thomomys fulvus intermedius Mearns, Proc. U. S. Nat. Mus., XIX, 1897, 719, July 30, 1897.

Type.—Collected on summit of Huachuca Mountains (9,000 feet altitude) southern Arizona, by F. X. Holzner, September 6, 1893. Type specimen in U. S. Nat. Mus.

Distribution.—Upper slopes of mountains in southeastern Arizona and extreme southwestern New Mexico (fig. 8).

Characters.—Smaller than *fulvus*, with conspicuous black back and bright brown sides; skull small and slender; ears and claws medium; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—Upperparts dark tawny shading into black along the back from nose to tail, in some specimens forming a broad and clear black band and in others indistinct and brownish black; underparts pale tawny; tail brown, with whitish tip; feet soiled whitish. May, August, and September specimens show practically the same coloration.

Skull.—Small and slender; zygomata very slender and strictly parallel; nasals narrow, deeply emarginate; bullæ small and flattened; basioccipital triangular; pterygoids thickened at base and with narrow fossa; interparietal small and generally triangular. *Dentition* light.

Measurements.—Type (♂ ad.): Total length, 200; tail vertebræ, 66; hind foot, 26. Adult male from Fort Huachuca: 200, 59, 27. Adult female from Fort Huachuca: 198, 62, 25. *Skull* (of type): Basal length, 34; nasals, 13; zygomatic breadth, 22; mastoid breadth, 18; interorbital breadth, 7; alveolar length of upper molar series, 6.5.

Remarks.—This small, black-backed form of the *fulvus* group has a wide and scattered range with considerable variation on the different mountains. On top of the Chiricahua Mountains it is a little larger than typical; on the crest of Animas Peak, a little smaller; on the

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[1] In Detrital Valley.

Santa Catalina Mountains, slightly larger and darker. Variation in size corresponds somewhat with the extent of high mountain areas which the animals inhabit, the smallest specimens being from the very restricted summit of the Animas Mountains. The difference between those from the tops of the Animas and the Huachuca Mountains is slight, however, compared with that between specimens of *intermedius* from the summit and *toltecus* from the base of either range.

Specimens examined.—Total number, 63, as follows:

Arizona: Chiricahua Mountains, 22; Fly Park (at 9,000 feet altitude), 1; Graham Mountains (8,500 to 9,200 feet), 8; head of Rucker Canyon, 2; Huachuca Mountains (up to 9,000 feet), 19; Mount Graham, 3; Santa Catalina Mountains (8,000 feet), 6.

New Mexico: Animas Mountains (7,000 feet), 2.

THOMOMYS FULVUS TEXENSIS Bailey.

Davis Mountain Pocket Gopher.

(Pl. IV, fig. 4.)

Thomomys fulvus texensis Bailey, Proc. Biol. Soc. Washington, XV, 119, 1902.

Type.—Collected on Davis Mountains, Texas (head of Limpia Creek, at 5,500 feet altitude, in edge of Transition Zone), by Vernon Bailey, January 7, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 7).

Characters.—Similar to *fulvus*, but smaller; hind foot 24–27 mm.; skull relatively narrower; color slightly lighter; mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts tawny-gray; underparts brighter clearer tawny; ear patch, nose, and cheeks blackish; feet and lips gray; lining of pouches white. *Winter pelage:* Slightly duller and darker than in summer.

Skull.—Light and slender, distinguished from that of *fulvus* by high narrow braincase, shallower lateral pits of palate, and shorter pterygoids.

Measurements.—Type (♂ ad.): Total length, 204; tail vertebræ, 63; hind foot, 26. Average of 5 topotypes (♂ ad.): 203, 65, 26.6. Average of 5 females: 187, 61, 25.8. *Skull* (of type): Basal length, 34.5; nasals, 13; zygomatic breadth, 22; mastoid breadth, 18; alveolar length of upper molar series, 7.

Remarks.—This is evidently a small local race of *fulvus*, as shown by similarity of skull characters and also by color and general characters. It is evidently isolated in the Transition Zone area of the Davis Mountains, but not widely separated from more nearly typical *fulvus* of the Guadalupe Mountains.

Specimens examined.—Twenty, from type locality.

THOMOMYS FULVUS TOLTECUS Allen.

Toltec Pocket Gopher.

(Pl. VI, fig. 3.)

Thomomys toltecus Allen, Bul. Am. Mus. Nat. Hist., V, 52, Apr. 28, 1893.

Type.—Collected at Colonia Juarez, Mexico (on the Casas Grandes River at about 4,500 feet altitude in northwestern Chihuahua), by F. Robinette,[1] 1890. Labeled "Juarez, N. Sonora." Type specimen in Am. Mus. Nat. Hist.

Distribution.—Lower Sonoran valleys and deserts of southeastern Arizona, southwestern New Mexico, and adjacent parts of Chihuahua and Sonora, south to Colonia Juarez, Chihuahua (fig. 7).

Characters.—Size about as in *fulvus* or slightly larger; colors paler and grayer; ears and claws medium; mammæ in 4 pairs.

Color.—*Summer pelage* (June specimens from Casas Grandes): Upperparts dull ochraceous-tawny; nose brownish; ear patch black; underparts lighter ochraceous-tawny; tail buffy gray; feet whitish. *Winter pelage:* Upperparts dark gray with a tawny suffusion over sides, and usually an indistinct dusky median line along back; nose and ear patch dusky; underparts light fawn or pinkish buff.

Skull.—Very like that of *fulvus* but more angular, less arched, with wider nasals, larger bullæ, and about the same dentition.

Measurements.—Adult male from Casas Grandes: Total length, 221; tail vertebrae, 72; hind foot, 31.5. Adult female from same locality: 205, 66, 29. *Skull* (of male): Basal length, 37; nasals, 13; zygomatic breadth, 25; mastoid breadth, 20.5; interorbital breadth, 7; alveolar length of upper molar series, 7.8. *Skull* (of type): 41, 14, 26, 21, 7, 8.

Remarks.—This is a light-colored valley form of the *fulvus* group occupying the upper edge of Lower Sonoran deserts of southern New Mexico and Arizona and northern Chihuahua. It is readily distinguishable from the smaller and grayer *lachuguilla* of the Rio Grande Valley, which occurs also at Casas Grandes and seems to be distinct. In Arizona it may grade into *cervinus* of the Gila Valley and in Sonora possibly into *sinaloæ*.

Specimens examined.—Total number, 175, as follows:

Arizona: Calabasas, 5; Chiricahua Mountains, 4; Dos Cabesas, 1; Fairbank, 24; Fort Bowie, 6; Fort Grant, 4; Fort Huachuca, 5; Fort Lowell, 12; Graham Mountains (Ash Creek, at 6,100 feet altitude), 3; Huachuca Mountains, 9; La Osa, 11; Mammoth, 1; Oracle, 2; Safford, 9; San Bernardino Ranch (Mexican boundary), 33; San Xavier, 1; Tucson, 2; Wilcox, 2.

Chihuahua: Casas Grandes, 2; Colonia Diaz, 3; Colonia Juarez, 6; Espia, 1.

New Mexico: Adobe Ranch (north base Animas Mountains), 1; Cuchillo, 1; Deming, 3; Garfield, 2; Hachita, 3; Lake Valley, 2; Las Palomas, 2; Mimbres River, 1; Monument No. 40, Mexican boundary, (upper corner, 100 miles west of El Paso), 3; Red Rock, 3.

Sonora: Santa Cruz River, 8.

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[1] The original label bears the name F. Robinette, but in the original description A. D. Meed was given as the collector.

THOMOMYS MEARNSI Bailey.

Mearns Pocket Gopher.

(Pl. VI, fig. 4.)

Thomomys mearnsi Bailey, Proc. Biol. Soc. Washington, XXVII, 117, July 10, 1914.

Type.—Collected at Gray's Ranch in Animas Valley, southwest corner of New Mexico (about 20 miles north of the Mexican line), by E. A. Goldman, August 10, 1908. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 7).

Characters.—Slightly smaller than *fulvus;* less dusky in color; skull short and wide with very slender, projecting incisors; ears medium; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts dull cinnamon or light tawny, with blackish nose and ear patches; underparts pale cinnamon; tail buffy gray; feet whitish. *Winter pelage:* Evidently more grayish as indicated by some worn patches of old long fur.

Skull.—Short and wide, with arched zygomata, short braincase, short rostrum, and protruding upper incisors; bullæ very short and round; pterygoids V-shaped; nasals short and truncate or slightly emarginate; anterior base of zygoma convex against frontal and premaxillæ. *Dentition:* Incisors very slender, pale, and protruding far beyond nasals; distinctly grooved.

Measurements.—Type: Total length, 220; tail vertebræ, 67; hind foot, 31. Topotype (♀ ad.): 201, 65, 29. *Skull* (of type): Basal length, 37; nasals, 12.4; zygomatic breadth, 26; mastoid breadth, 21.5; interorbital breadth, 6; alveolar length of upper molar series, 7.

Remarks.—This seems to be a local form in the bottom of the Animas Valley, somewhat resembling *nelsoni* but not of the *umbrinus* group. The four pairs of mammæ place it in the *fulvus* group, but it seems to be distinct from the surrounding *toltecus.* Specimens were taken around the moist edges of a large marsh on the Gray Ranch and the moist, alkaline soil may be the environmental factor that has produced a local form in the midst of wide deserts. It is quite probable that the form occupies similar situations all along the Animas and San Simon Valleys.

Specimens examined.—Four, from type locality.

THOMOMYS BAILEYI Merriam.

Sierra Blanca Pocket Gopher.

(Pl. VI, fig. 7.)

Thomomys baileyi Merriam, Proc. Biol. Soc. Washington, XIV, 109, July 19, 1901.

Type.—Collected at Sierra Blanca, El Paso County, Texas, by Vernon Bailey, December 28, 1889. The type and topotypes were caught all around the railway station where the Texas Pacific joins the Southern Pacific. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Sierra Blanca, western Texas, north to Tularosa, N. Mex. (fig. 7).

Characters.—Size medium, hind foot 29–32 mm.; color, dull ochraceous-tawny; skull short and wide with projecting incisors; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Fresh winter pelage:* Upperparts dull ochraceous-tawny or buffy fulvous, with dusky ear patch and nose; underparts pale salmon or creamy white; tail buffy to the tip; feet soiled whitish. *Summer pelage:* Not represented.

Skull.—Short and wide, with greatly protruding incisors; basioccipital wide between the narrow bullæ; premaxillæ extending but slightly back of nasals; interparietal quadrate; anterior base of zygoma convex; coronoid process of mandible curved, and postcoronoid notch widely circular.

Measurements.—Topotype (♂ ad.): Total length, 215; tail vertebræ, 64; hind foot, 31. Average of five females: 212, 69, 29. *Skull* (of type): Basal length, 37; nasals, 17.7; zygomatic breadth, 26.5; mastoid breadth, 19; alveolar length of upper molar series, 7.5.

Remarks.—In wide skull and projecting incisors *baileyi* suggests the *umbrinus* group, but as no other detailed characters of the group appear the resemblance is evidently accidental. Nine specimens from Tularosa, N. Mex., average larger and darker colored than those of the type series, but show the prominent cranial characters. There is nothing to indicate that the species has a continuous range between these localities, but it is not improbable that it follows along the west base of the Sacramento Mountains in the Upper Sonoran or the upper edge of the Lower Sonoran Zone. The Tularosa specimens suggest a distant connection with the *fulvus* group.

Specimens examined.—Total number, 15, as follows:

New Mexico: Tularosa, 9.
Texas: Sierra Blanca, 6.

THOMOMYS LACHUGUILLA Bailey.

Lachuguilla Pocket Gopher.

(Pl. VI, fig. 8.)

Thomomys aureus lachuguilla Bailey, Proc. Biol. Soc. Washington, XV, 120, June 2, 1902.

Type.—Collected at El Paso, Texas (in a dry wash in the mountains a mile northeast of the town), by Vernon Bailey, September 24, 1901. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Arid Lower Sonoran mesas in extreme western Texas and southern New Mexico, south to Casas Grandes, Chihuahua (fig. 7).

Characters.—Size small, hind foot 27–29 mm.; color, dull ochraceous-tawny; skull narrow with abruptly decurved incisors; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—Upperparts dull ochraceous-tawny or grayish buff; nose and ear patch dusky; underparts pale cinnamon to soiled whitish; feet whitish.

Skull.—Resembling that of *aureus* in general form, with full rounded bullæ, narrow basioccipital, and slightly arched palate, but differing in its smaller size, slenderer form, and less-ridged surface; interparietal normally quadrate; slender points of premaxillæ extending far back of truncate or slightly emarginate tip of nasals.

Measurements.—Type (♂ ad.): Total length, 215; tail vertebræ, 65; hind foot, 29. Average of five topotypes (♂ ad.): 202, 61, 27. Average of three females: 195, 62, 26. *Skull* (of type): Basal length, 35; nasals, 14; zygomatic breadth, 22; mastoid breadth, 19; alveolar length of upper molar series, 7.

Remarks.—This form needs no comparison with *baileyi* on the east or *perditus* on the south. It was originally, but probably erroneously, considered a small, dull-colored desert form of *aureus*. It occupies the arid Lower Sonoran mesas, but apparently does not occur in moist and fertile bottom lands as do the more robust *aureus* and *toltecus*. Specimens from Presidio County and the Great Bend region are not typical, but they vary so much with each locality that to avoid making more subspecies I have referred them to this, the nearest form. It seems probable that the great variation in the gophers of this region is due to the scarcity of individuals and the isolation of colonies.

Specimens examined.—Total number, 33, as follows:

Chihuahua: Casas Grandes, 2.

New Mexico: Organ, 2; Organ Mountains, 2.

Texas: Alpine, 1; Boquillas, 2; El Paso, 12; Franklin Mountain (10 miles north of El Paso, 4; and 15 miles north, 2), 6; Marathon (15 miles south), 1; Paisano, 1; Presidio County (35 miles south of Marfa), 4.

Thomomys umbrinus Group.

THOMOMYS UMBRINUS UMBRINUS (Richardson).

Southern Pocket Gopher.

(Pl. II, fig. 13; Pl. VI, fig. 13; text fig. 2.)

Geomys umbrinus Richardson, Fauna Boreali-Americana, I, 202, 1829.
Thomomys umbrinus Bailey, Proc. Biol. Soc. Washington, XIX, 3, Jan. 29, 1906.

Type.—In British Museum, said to have come from "Cadadaguios, a town in southwestern Louisiana," but no such town has ever been located, except the Kadhoadacho Indian settlements on the Red River, in western Louisiana, where *Thomomys* does not occur. The type locality is now restricted to Boca del Monte, Vera Cruz. Type identified with specimens from Vera Cruz.[1]

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[1] Proc. Biol. Soc. Washington, XIX, 3, Jan. 29, 1906.

Distribution.—Known only from Boca del Monte and Xuchil, Vera Cruz (fig. 9).

Characters.—Size medium, hind foot 27–28 mm.; color dichromatic, dull umber, brown, or black; skull short and wide with emarginate anterior base of zygoma and strongly projecting incisors; groove on inner margin of incisors very obscure; ears small; claws very slender; mammæ in 3 pairs, inguinal 2–2, pectoral 1–1.

Color.—Upperparts in brown phase varying from dull burnt umber, or Prout's brown, to nearly black; underparts lightly washed with pale buff or whitish; chin, feet, and tip of tail white. In black phase, slaty black all over except white chin, feet, and tip of tail.

Skull.—Light and smooth, not ridged or angular, short and wide, with very short rostrum and greatly projecting incisors; anterior base of zygoma emarginate or concave in outline where it joins the frontal; lachrymal long and attached for all or most of its length to zygoma; premaxillæ widening posteriorly and terminating approximately even with nasals; palate flat, not arched between molar series; lateral pits deep; base of pterygoids constricted. *Dentition* light; incisors slender, projecting, pale or whitish, with indistinct or obsolete inner groove; anterior lower incisor with anterior enamel plate minute or often entirely wanting.

Measurements.—Average of 4 topotypes (♂ ad.): Total length, 193; tail vertebræ, 58; hind foot, 27.2. Average of 3 adult females: 195, 57, 27. *Skull* (♂ ad.):[1] Basal length, 33.7; nasals, 12.4; zygomatic breadth, 24; mastoid breadth, 17.6; alveolar length of upper molar series, 7.3.

Remarks.—It would be useless to list the various species of *Thomomys* to which authors have applied the name *umbrinus*. For over half a century the name was shifted about to one and another species, and proved a stumbling block to every naturalist working on the genus. Fortunately the type is still extant and has been identified with a sufficiently restricted species to give it a definite location. The species thus becomes the type of a well-defined group, including *umbrinus*, *orizabæ*, *peregrinus*, *nelsoni*, *sheldoni*, *goldmani*, *perditus*, and *atrovarius*.

Specimens examined.—Total number, 15, as follows:

Vera Cruz: Boca del Monte, 8; Xuchil, 7.

THOMOMYS UMBRINUS ORIZABÆ MERRIAM.

ORIZABA POCKET GOPHER.

(Pl. VI, fig. 15.)

Thomomys orizabæ Merriam, Proc. Biol. Soc. Washington, VIII, 145, Dec. 29, 1893.

Type.—Collected on Mount Orizaba (9,500 feet altitude), Puebla, Mexico, by E. W. Nelson and E. A. Goldman, April 25, 1903. Type specimen in U. S. Nat. Mus., Biological Survey collection.

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[1] No. 66091, U. S. Nat. Mus., from Boca del Monte, Vera Cruz.

Distribution.—Known only from type locality (fig. 9).

Characters.—Considerably larger than *umbrinus* or *peregrinus;* hind foot 27–31 mm.; skull heavier; colors dichromatic, usually black, rarely bright umber; ears small; claws slender; mammæ in 3 pairs.

Color.—In 14 of 16 topotypes: Glossy iridescent black all over except white on tip of tail, toes, and usually chin and inside of pockets. Two topotypes in brown phase: Upperparts bright burnt umber in the adult, darker in the immature specimen; underparts washed with paler shade of the same or ochraceous-buff; tip of tail, toes, and inside of pockets white.

Skull.—Relatively more elongated, angular, and ridged than in *umbrinus* or *peregrinus;* base of zygoma deeply concave, or emarginate; lachrymal long and borne mainly on zygoma; premaxillæ widening posteriorly and terminating approximately even with nasals; palate flat between molars, but with deep lateral pits and constricted base of pterygoids. *Dentition* heavy; incisors less projecting than in *peregrinus*, and plain orange, rarely with white tips; anterior enamel plate of front lower incisor small.

Measurements.—Average of 4 topotypes (♂ ad.): Total length, 219; tail vertebræ, 69; hind foot, 29.3. Average of 5 females: 132, 66, 29. *Skull* (of type, ♀ ad.): Basal length, 35; nasals, 13; zygomatic breadth, 25; mastoid breadth, 19; alveolar length of upper molar series, 7.7. One topotype (♂ ad.):[1] 38.5, 14, 25, 19.5, 8.

Specimens examined.—Sixteen, from type locality.

THOMOMYS UMBRINUS PEREGRINUS MERRIAM.

MEXICAN POCKET GOPHER.

(Pl. VI, fig. 14.)

Thomomys peregrinus Merriam, Proc. Biol. Soc. Washington, VIII, 146, Dec. 29, 1893.

Type.—Collected at Salazar, Federal District of Mexico, Mexico, at 10,300 feet altitude, by E. W. Nelson and E. A. Goldman, October 24, 1892. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Mountain slopes in the Federal District of Mexico, east to San Martin, Puebla, and north to El Chico, Hildago (fig. 9).

Characters.—Size medium, slightly larger than *umbrinus;* hind foot 27–29 mm.; color dark rich umber; skull with projecting incisors and concave base of zygoma; mammæ in 3 pairs.

Color.—Upperparts dark rich burnt umber, becoming blackish along the back in many specimens; underparts washed with ochraceous-buff; feet, tip of tail, and sometimes chin, whitish. A fully melanistic specimen from Santa Rosa, Guanajuato, suggests partial dichromatism.

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[1] No. 53611, U. S. Nat. Mus.

Skull.—Less markedly short and wide than in *umbrinus* and with slightly less projecting incisors; base of zygoma slightly concave; palate flat between molar series, and unique in having shallow lateral pits and wide base of pterygoids. *Dentition* light; incisors bright orange with white tips; anterior enamel plate on front lower incisors small but distinct and constant.

Measurements.—Average of 3 topotypes (♂ ad.): Total length, 208; tail vertebræ, 61; hind foot, 28. Average of 5 females: 189, 59, 27.3. *Skull* (of type, ♀ ad.): Basal length, 34; nasals, 12; zygomatic breadth, 23; mastoid breadth, 18; alveolar length of upper molar series, 7. Skull of topotype (♂ ad.):[1] 34, 12.3, 24, 19, 7.

Specimens examined.—Total number, 43, as follows:

Hidalgo: El Chico (Sierra de Pachuca), 3; Real del Monte, 3; Tulancingo, 1.
Mexico: Popocatepetl, 1; Salazar, 17; Toluca Valley, 1; Volcan Toluca (north slope), 15.
Puebla: San Martin, 2.

THOMOMYS NELSONI MERRIAM.

NELSON POCKET GOPHER.

(Pl. VI, fig. 11.)

Thomomys nelsoni Merriam, Proc. Biol. Soc. Washington, XIV, 109, July 19, 1901.

Type.—Collected at Parral, Chihuahua, Mexico, at 6,000 feet altitude, by E. W. Nelson and E. A. Goldman, September 18, 1898. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Central Chihuahua, from Gallego south to Parral (fig. 9).

Characters.—Size small, hind foot 28 mm.; color bright tawny; skull short and wide, with projecting incisors.

Color.—*Winter pelage:* Upperparts light russet or bright tawny, darker along back and on face; nose and ear patch blackish; ankle and base of tail brownish, lower part of feet and terminal part of tail white; belly pale tawny. *Summer pelage:* A shade brighter above and below.

Skull.—Short and wide with abruptly spreading zygomata and strongly projecting, lightly grooved, white-tipped incisors; nasals narrow, cuneate, slightly notched, and terminating a little short of the wide posterior tips of premaxillæ; basioccipital wide and flat; frontals wide, crowding slightly into base of zygomata; lachrymal mainly adnate to zygoma.

Measurements.—Type (♂ ad.):[2] Total length, 196; tail vertebræ, 60; hind foot, 28. Topotype (♂ ad.): 207, 59, 28.5. *Skull* (of type): Basal length, 37; nasals, 13; zygomatic breadth, 24; mastoid breadth,

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[1] No. 50122, U. S. Nat. Mus.

[2] The type of *nelsoni* was marked "♀" on the original label and referred to in original description as female. It is, however, a fine old male with prominent sex marks showing in the skin and with the skull characters of the male.

21; alveolar length of upper molar series, 7. Skull of male topotype: 34, 12, 24, 19.5, 7.

Remarks.—The short, wide skull, projecting incisors, and white slippers and tip of tail reveal relationship with the *umbrinus* group, although in the specimens collected there are no females to show the arrangement of mammæ. However, *nelsoni* is evidently a northern form of the group.

Specimens examined.—Total number, 3, as follows:

Chihuahua: Gallego, 1; Parral, 2.

THOMOMYS SHELDONI.[1] SP. NOV.

SHELDON POCKET GOPHER.

(Pl. VI, fig. 12.)

Type from Santa Teresa (6,800 feet altitude), Tepic, Mexico. Adult ♂, No. 90819, U. S. Nat. Mus., Biological Survey collection. Collected August 10, 1897, by E. W. Nelson and E. A. Goldman; collectors' number, 11443.

Distribution.—Transition Zone on the Sierra Madre, Mexico, from northern Chihuahua south to Guanajuato (fig. 9).

Characters.—In size slightly larger than *umbrinus* or *peregrinus*, and more brightly colored than either; ears small; claws slender; skull relatively long, with long nasals and not very protruding incisors; mammæ in 3 pairs.

Color.—*Summer pelage:* Upperparts light umber, or russet-brown, darker along median line of back, on nose, and about ears; underparts lighter, more tawny; lower half of feet and tip of tail usually white; rarely any white on chin or throat in typical series; white lining of cheek pouches scarcely showing. *Young* duller and darker.

Skull.—Relatively longer than in other members of the group, with longer, narrower nasals and slender rostrum; interorbital region wide and flat; interparietal triangular; nasals slightly emarginate, usually falling short of posterior tips of premaxillæ; anterior base of zygoma nearly straight, in some slightly concave and in others slightly convex; lachrymal adnate to zygoma for over half its length. *Dentition:* Incisors moderately projecting, dark orange, with small but distinct grooves along inner margins.

Measurements.—Type (♂ ad.): Total length, 210; tail vertebræ, 64; hind foot, 29. Average of 4 topotypes (♂ ad.): 200, 62, 28.8. Average of 4 adult females: 191, 61, 28.5. *Skull* (of type): Basal length, 37; nasals, 14.5; zygomatic breadth, 25; mastoid breadth, 19; interorbital breadth, 7; alveolar length of upper molar series, 8.

Remarks.—This is a northern form of the *umbrinus* group, occupying the Transition Zone of the main Sierra Madre of Mexico, and probably separated by lower country from the range of *peregrinus*, its nearest relative. There is considerable variation in its extension northward to northern Chihuahua but no indication of its intergradation with *intermedius*, which is very similar in general appearance but which with its 4 pairs of mammæ and narrow, slender skull, belongs to the *fulvus* group.

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[1] Named for Charles Sheldon in recognition of his interest in mammals, large and small, and his many contributions of specimens and of notes on their habits.

Specimens examined.—Total number, 117, as follows:

Chihuahua: Chuichupa, 1; Colonia Garcia (6,400 feet altitude), 13; near Guadelupe y Calvo (at 7,000 feet), 6; Pacheco, 11; Sierra Madre (65 miles east of Batopilas at 7,000 feet), 5.

Durango: Chacala (3,000 feet), 1, immature; Coyotes, 3; El Salto (8,400 feet), 10; La Boca, 1; Rio Sestin, 1.

Guanajuato: Santa Rosa (8,500 feet), 9.

San Luis Potosi: La Tinaja (6,000 feet), 8; San Luis Potosi, 1.

Sinaloa: Sierra de Choix (50 miles northeast of Choix at 5,000 feet), 3.

Sonora: Alamos (1,200 feet), 5.

Tepic: Santa Teresa (6,800 feet), 10.

Zacatecas: Berriozabal (6,600 feet), 10; Plateado, 4; Sierra Madre (8,500 feet), 5; Valparaiso Mountains (8,700 feet), 10.

THOMOMYS GOLDMANI MERRIAM.

GOLDMAN POCKET GOPHER.

(Pl. VI, fig. 10.)

Thomomys goldmani Merriam, Proc. Biol. Soc. Washington, XIV, 108, July 19, 1901.

Type.—Collected at Mapimi, Durango, Mexico, by E. A. Goldman, December 15, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Eastern Durango, from Mapimi south to Durango City (fig. 9).

Characters.—Size small, hind foot 27–30 mm.; color bright tawny above, white below; ears minute; skull short and wide, with projecting incisors; mammæ in 3 pairs, inguinal 2–2, pectoral 1–1.

Color.—Upperparts bright tawny, darkening on head and becoming dusky around nose and ears; underparts, tip of tail, and lower part of feet, white.

Skull.—Short and wide with very short nasals and projecting incisors; zygomatic arches slender, nearly parallel, abruptly constricted at posterior base; basioccipital wide and flat; nasals nearly truncate, falling slightly short of posterior tips of premaxillæ; frontals wide, pushing slightly into base of zygomata; lachrymal lying mainly against base of zygoma, as in *umbrinus*.

Measurements.—Type (♂ ad.): Total length, 208; tail vertebræ, 68; hind foot, 30. Female topotype: 190, 60, 27. *Skull* (of type): Basal length, 33; nasals, 12; zygomatic breadth, 22; mastoid breadth, 18; alveolar length of upper molar series, 7.

Remarks.—The specimens from Mapimi exhibit the extreme differentiation of the form. Those from Durango are darker, more nearly like *peregrinus*, through which *goldmani* evidently connects with the *umbrinus* group.

Specimens examined.—Total number, 9, as follows:

Durango: Durango, 6; Mapimi, 2; San Gabriel, 1.

THOMOMYS PERDITUS MERRIAM.

LITTLE GRAY POCKET GOPHER.

(Pl. VI, fig. 9.)

Thomomys perditus Merriam, Proc. Biol. Soc. Washington, XIV, 108, July 19, 1901.

Type.—Collected at Lampazos, Nuevo Leon, Mexico, by Clark P. Streator, January 22, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Eastern Coahuila and western Nuevo Leon, north to Rock Springs and Castle Mountains, western Texas (fig. 9).

Characters.—Size small, hind foot 25 mm.; color buffy gray or pale tawny; skull short and narrow, with slightly projecting incisors; mammæ in 3 pairs, inguinal 2–2, pectoral 1–1.

Color.—Upperparts dark buffy gray or pale dull tawny, darkest along back; sides brighter; belly and feet pale buffy or creamy white; ear patch, nose, and lips dusky; inside of pouches white.

Skull.—Short, with smooth, rounded braincase and rectangular zygomatic arches; incisors projecting slightly beyond nasals; nasals sharply notched posteriorly and terminating on a plane with short premaxillæ; interparietal normally quadrate, wider than long; anterior base of zygoma strongly convex in outline, unlike most species of the *umbrinus* group.

Measurements.—Type (♂ ad.): Total length, 195; tail vertebræ, 59; hind foot, 26.5. Average of 2 topotypes (♂ ad.): 192, 58, 26.8. Average of 2 females: 180, 54, 24.5. *Skull* (of type): Basal length, 33; nasals, 12; zygomatic breadth, 21; mastoid breadth, 18; alveolar length of upper molar series, 7.

Remarks.—The relationships of this species, as exhibited by the cranial characters, seem not to be very close with any of the surrounding forms, but the number and arrangement of mammæ place it in the *umbrinus* group.

Specimens examined.—Total number, 24, as follows:

Coahuila: Carneros, 5; Jaral, 1; Sierra Encarnacion, 1; Sierra Guadalupe, 4.
Nuevo Leon: Lampazos, 5; Villadama, 2.
Texas: Castle Mountains, 1; Comstock, 2; Devils River, 1; Rock Springs (35 miles east), 1; Samuels, 1.

THOMOMYS ATROVARIUS ALLEN.

BLACK-AND-BROWN POCKET GOPHER.

(Pl. VI, fig. 16.)

Thomomys atrovarius Allen, Bul. Am. Mus. Nat. Hist., X, 148, 1898.

Type.—Collected at Tatemales (near Rosario), Sinaloa, Mexico, by P. O. Simons, May 15, 1897. Type specimen in the British Museum.

Distribution.—Coastal Plain of southern Sinaloa and Tepic, from Mazatlan south to Colomo (fig. 9).

Characters.—Size medium, hind foot 30 mm.; pelage thin and harsh; color dark brown or blackish; skull short and wide, with projecting incisors; ears small; claws slender; mammæ in 3 pairs.

Color.—Dark umber, brown, or brownish black; underparts brownish or plumbeous; ears, feet, and tail nearly naked, but lower part of feet and tip of tail usually white when there is hair enough to show color.

Skull.—Slightly heavier and longer than in *umbrinus*, but of the same general characters, with short nasals and less-projecting incisors; base of zygoma slightly indented and the greater part of lachrymal adnate to it; posterior tips of premaxillæ narrowed and extending slightly back of truncate tip of nasals; pterygoids wide apart. *Dentition* slightly heavier than in *umbrinus;* incisors dark orange and very lightly grooved.

Measurements.—Average of 3 females from Rosario: Total length, 196; tail vertebræ, 68; hind foot, 29. Adult male from Mazatlan: 208, 66, 31. *Skull* (of adult male from Mazatlan): Basal length, 36; nasals, 13; zygomatic breadth, 25; mastoid breadth, 20; alveolar length of upper molar series, 8.

Remarks.—*Thomomys atrovarius* is a well-marked, thin-haired, nearly concolor, tropical species in which the skull characters show close affinities with the *umbrinus* group.

Specimens examined.—Total number, 14, as follows:

Sinaloa: Mazatlan, 2; Plomosas, 2; Rosario, 5; Tatemales, 1.
Tepic: Colomo, 1; Navarete, 2; Pedro Pablo, 1.

Thomomys talpoides Group.

THOMOMYS TALPOIDES TALPOIDES (RICHARDSON).

SASKATCHEWAN POCKET GOPHER.

Cricetus talpoides Richardson, Zool. Journ., III, 518, 1828.

Geomys talpoides Richardson, Fauna Boreali-Americana, 204, 1829.

S[accophorus] talpoides Fischer, Synopsis Mammalium, 588 ("388"), 1830. Taken from Richardson.

Geomys borealis Richardson,[1] Sixth Ann. Rept. Brit. Assn. for 1836, V, 150, 156, 1837. Renaming of *talpoides.*

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[1] *Geomys borealis* of Richardson has been generally considered a nomen nudum and the name dated from Bachman, two years later, based on a different species. Richardson first used the name (loc. cit., 150) as "Geomys borealis, Rich. nov. sp." On page 156 he states that "*Geomys borealis* inhabits the Plains of the Saskatchewan," and on page 157 he gives good descriptive characters in comparison with several other species. He says "*borealis* and *talpoides* have a very fine groove close to the inner margin of each upper incisor," but evidently failed to detect the much finer grooves on the incisors of *bulbivorus* and *umbrinus* with which he was making the comparison. As Dr. Allen has pointed out (Bul. Am. Mus. Nat. Hist., V, 61, 1893) Richardson was evidently renaming his *talpoides*, of which he here (p. 156) very strangely changes the habitat to Florida. It therefore seems necessary to consider *borealis* a synonym of *talpoides*. Bachman's *borealis* (1839), of which the type is extant and perfectly identifiable, is the same as *clusius* of Coues (1875).

Since writing the foregoing I have received a letter (Mar. 15, 1915) from Mr. Oldfield Thomas, of the British Museum, expressing his opinion that *borealis* of Richardson is not a nomen nudum.

Ascomys borealis Wagner, Suppl. Schreber Säug., III, 391, 1843. Taken from Richardson.

Geomys unisulcatus Gray, List Mamm. Brit. Mus., 149, 1843. Nomen nudum.

Saccophorus borealis Gray, List Mamm. Brit. Mus., 149, 1843. From Richardson.

Ascomys talpoides Wagner, Suppl. Schreber Säug., III, 390, 1843. From Richardson.

Ascomys borealis Wagner, Suppl. Schreber Säug., III, 391, 1843. From Richardson.

Pseudostoma talpoides Audubon & Bachman, Quad. N. Am., III, 43–45, 1854; described and figured from type specimen in collection Zool. Soc., London.

Geomys (*Thomomys*) *talpoides* Giebel, Säug., 530, 1855. Compiled from Richardson.

Thomomys talpoides Baird, Mamm. N. Am., 403, 1857.

Type.[1]—Type locality fixed at near Fort Carlton (Carlton House) on the Saskatchewan River, Saskatchewan. Type specimen in British Museum, a stuffed skin and anterior part of skull, which was removed from the skin in 1893.

Distribution.—Plains of Saskatchewan and Alberta; south in Montana to Great Falls and the Big Snowy Mountains (fig. 10).

Characters.—Size medium, between that of *rufescens* and *clusius;* ears prominent and pointed; claws slender; color dull and dark gray; skull not heavily ridged and with slight temporal ridges often converging anteriorly or in the middle; nasals emarginate posteriorly; rostrum slender; mammæ normally in 6 pairs, inguinal 2–2, abdominal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts dull grayish brown with plumbeous nose and blackish ear patch; underparts buffy or soiled whitish gray; chin, and often throat and breast, pure white; feet whitish; tail white tipped or sometimes all white. *Winter pelage:* Upperparts dull dark gray, with little brownish; ear patch black; underparts washed with whitish.

Skull.—Rather short and wide, with anteriorly converging temporal ridges in all but very old individuals; nasals emarginate at posterior tips or rarely truncate; interparietal triangular; audital bullæ full and wide but low, with anterior arm of basioccipital narrow between them. *Dentition* noticeably lighter than in *rufescens;* upper incisors abruptly decurved and distinctly grooved.

Measurements.—Largest male from Borden, Saskatchewan: Total length, 214; tail vertebræ, 60; hind foot, 28. Largest female from same place: 210, 60, 29. Skull (♂ ad. from Borden, Saskatchewan): Basal length, 34.5; nasals, 14; zygomatic breadth, 23; mastoid breadth, 19; interorbital breadth, 6; alveolar length of upper molar series, 7.

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[1] The type of *talpoides*, a stuffed skin with part of skull, was procured from Mr. Leadbeater, a London dealer, and was recorded from "Hudson Bay." This evidently meant the country of the Hudson's Bay Co., or western Canada. There are no gophers known nearer the shores of Hudson Bay than on the Saskatchewan, where, as Dr. Allen has pointed out, Richardson refers to them in his original description. Carlton House or Fort Carlton, where Richardson remained for some time, and apparently the highest point he reached on the Saskatchewan River, is near the easternmost point at which these gophers are known to occur along the river. As other species are found farther west on the Saskatchewan, it is necessary to restrict the type locality of *talpoides* still further to the vicinity of Carlton House.

Remarks.—The name *talpoides* has long been applied to the gophers of North Dakota and Manitoba on the supposition that they were the same as those from the Saskatchewan. A series of specimens recently collected at Borden, Saskatchewan, the lowest point at which they could be found along the North Saskatchewan River, and only about 40 miles above the site of old Fort Carlton, prove to be separable from the Dakota animal, which therefore takes the name *rufescens.* The fact that Richardson did not get specimens or even see the gopher which he described is probably due to their absence from the immediate vicinity of Fort Carlton where he records them in an indefinite way. He may have seen their molelike mounds on a short trip up the river or may only have heard of them from trappers and other explorers in that region, possibly from Drummond or Douglas. It, therefore, seems safe to assume that specimens from Borden are typical of *talpoides* of Richardson.

Loring reports gopher hills 20 miles, and Preble 40 miles, north of Edmonton.

Specimens examined.—Total number, 98, as follows:

Alberta: Blindman River, 4; Buffalo Lake, 2; Calgary, 2; Didsbury, 2; Edmonton, 22; Irwin Lake, 1; Red Deer, 23; St. Albert, 2; Waghorn, 1.

Montana: Bearpaw Mountains, 1; Big Snowy Mountains, 2; Blackfoot, 12; Highwood, 3; Zortman, 1.

Saskatchewan: Borden, 16; Indian Head, 4.

THOMOMYS TALPOIDES RUFESCENS WIED.

PRAIRIE POCKET GOPHER; DAKOTA POCKET GOPHER.

(Pl. I; Pl. II, fig. 5; Pl. VII, fig. 1; text figs. 2, 3).

Thomomys rufescens Wied, Nova. Acta. Phys. Med. Acad. Cæs. Leop.-Carol, XIX, pt. 1, 378, 1839.

Type.—Collected at "The Minnetaree Village," now Old Fort Clark, Oliver County, North Dakota (about 6 miles south of Stanton), on the west side of the Missouri River, by Maximilian, Prince of Wiedin. 1833. Type specimen in Am. Mus. Nat. Hist.

Distribution.—Greater part of North Dakota, eastern South Dakota, and southwestern Manitoba (fig. 10).

Characters.—Size large; feet large and claws stout; ears prominent and pointed, not a mere thickened rim as in some western species; color dull and dark gray; skull heavy, with parallel temporal ridges and wide basioccipital; rostrum slender; incisors abruptly decurved, distinctly grooved; mammæ in 6 pairs, inguinal 2–2, abdominal 2–2, pectoral 2–2.

Color.—*Thin summer pelage* (July and August): Upperparts dull brownish gray; ear and surrounding fur black; underparts buffy gray with more or less pure white on chin, throat, and breast; feet whitish; tail whitish or gray at base. *Early winter pelage* (October): Dark buffy gray above, almost as dark as in summer. *Full winter pelage*

(November to May): Bright buffy gray above, fading to paler buffy in spring. *Young*: Upperparts duller, more plumbeous, fading to buffy when half grown, changing to dark fall pelage in October. [See section on molt (p. 18); also five molts shown on one animal in fig. 3, No. 1.]

Skull.—Long and straight, with shallow rostrum and strongly developed and approximately parallel temporal ridges; nasals long and truncate or rounded at posterior tip; bullæ long and rather narrow (becoming very narrow in specimens from the eastern part of the range), basioccipital with wide, heavy shaft between bullæ; auditory meatus slender. *Dentition:* Molars heavy; incisors decurved at right angle to axis of skull.

Measurements.—Adult male from near Fort Clark, N. Dak.: Total length, 240; tail vertebræ, 70; hind foot, 31. Adult female from same locality: 230, 70, 31. *Skull* (of adult male from near Fort Clark): Basal length, 40; nasals, 15.5; zygomatic breadth, 25; mastoid breadth, 22; interorbital breadth, 7; alveolar length of upper molar series, 8.

Remarks.—There is now ample material from the type locality and its general region to show the characters of *rufescens*, which proves to be the large, dark-colored gopher occupying the greater part of North Dakota, eastern South Dakota, and southwestern Manitoba. Specimens from the type region in early winter fur (November or December) are still needed to complete our knowledge of seasonal variation in pelage, but this pelage will probably be found to agree, as do most other characters, with specimens from the eastern part of the State.

The type, a mounted specimen with skull inside, much faded but otherwise in good condition, is in the American Museum of Natural History. It has been removed from the base, and the old label, once tacked on the base, is now attached to the foot. It bears the legend "*Thomomys rufescens* Wied. Machtohpka indigen" and also "Mas Missouri," not very legible. It hardly seemed necessary to remove the skull from so old and fragile a specimen, as there are good topotypes, and the general size and large claws are good characters. The hind foot measures 30 mm., dry. It is marked "♂" on the museum label, which also is attached to the foot.

Specimens examined.—Total number, 159, as follows:

Manitoba: Aweme, 4; Carberry, 11; Selkirk Settlement, 1.

North Dakota: Bismarck, 4; Bottineau, 1; Braddock, 1; Cannonball River, 6; Devils Lake, 1; Dickinson, 2; Fish Lake (in Turtle Mountains), 8; Fort Clark, 5; Fort Rice, 1; Glen Ullin, 1; Grafton, 3; Hensler, 6; Jamestown, 6; Larimore, 7; Mandan, 10; Minnewauken, 3; Minot, 1; Oakdale, 8; Pembina, 25; Portland, 1; Sherbrooke, 6; Souris River, 2; Steel 1; Streeter, 2; Stump Lake, 1; Valley City, 9; Wade, 2; Walhalla, 2; Washburn, 3.

South Dakota: Aberdeen, 2; Armour, 3; Fort Randall, 2; Fort Sisseton, 3; Highmore, 1; Pierre, 3; White Lake, 1.

THOMOMYS TALPOIDES CLUSIUS Coues.

Coues Pocket Gopher.

(Pl. II, fig. 6; Pl. VII, fig. 5; text fig. 3.)

Geomys borealis Bachman,[1] Journ. Acad. Nat. Sci. Phila. VIII, pt. 1, 103, 1839. Type locality said to be the "Columbia River," probably in Colorado near the southeast corner of Wyoming. (Not of Richardson.)

Pseudostoma borealis Audubon & Bachman, Quad. N. Am., III, 198, pl. 142, 1853. (Not *Geomys borealis* of Richardson.)

Thomomys clusius Coues, Proc. Acad. Nat. Sci. Philadelphia, 1875, 138, June 15, 1875.

Type.—Collected at Bridgers Pass, Carbon County, Wyoming, (18 miles southwest of Rawlins), by Dr. W. A. Hammond, July 28, 1857. Type specimen in U. S. Nat. Mus.

Distribution.—Central and southeastern Wyoming (north to Parkman, Sheridan County), and eastern Colorado south to Colorado Springs (fig. 10).

Characters.—Considerably smaller than *talpoides*, with slenderer claws; color slightly more rufescent; skull with the same shallow rostrum, but differing in having smaller size, large rounded bullæ, and lighter dentition; mammæ in 6 or 7 pairs, inguinal 2–2, abdominal 2–2, pectoral 2–2, or sometimes 3–3; embryos 5 to 7.

Color.—*Summer pelage:* Upperparts light buffy- or hazel-gray, brightest on crown, paler along sides; cheeks clear gray; ear patch blackish; underparts whitish or buffy; chin sometimes white; feet and tip of tail whitish. *Autumn pelage* (September): Upperparts duller and darker; crown and back dull hazel darkened with black-tipped hairs that apparently fade or wear off and leave a grayish or buffy brown in winter; black ear patch conspicuous. *Young* paler, more buffy gray.

Skull.—Light and slender, not angular or heavily ridged; temporal ridges parallel in fully adult specimens; audital bullæ much larger and more rounded than in *talpoides;* anterior arm of basioccipital very narrow; nasals slenderer, especially at posterior tips, which are variously rounded, truncate, or slightly emarginate in the topotype series; interparietal small and triangular. *Dentition* conspicuously lighter than in *talpoides.*

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[1] Bachman's description of *Geomys borealis*, which he credits to Richardson, was based mainly on a specimen collected by Townsend, of which he says, "Mr. Townsend's specimens were procured on the Columbia River." The very full description of *borealis*, including measurements, agrees perfectly with one (No. 146) of the three specimens brought back by Townsend and now before me through the kindness of Dr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia. I have had the skulls removed from these three mounted specimens, and for the first time it is possible to identify them. The old labels which were formerly tacked on the stands are now attached to these specimens, and Dr. Stone thinks they are in the handwriting of Le Conte, who published on them in 1852, 18 years after they were collected. (Le Conte also described a *Geomys bursarius* as *Geomys oregonensis* from a specimen labeled "Columbia River, J. K. Townsend.") It is probable that the specimens came into the collection without labels, and were supposed to have come from the Columbia River, but none of the three of *Thomomys* were collected anywhere near the Columbia. No. 147 is Bachman's type of *townsendi* and No. 144 is an adult specimen of *pygmæus* which Bachman considered a young of *borealis*. Bachman's type of *borealis* proves to be identical with *clusius* of Coues. Townsend in his Narrative (p. 59) mentions a pocket gopher which he picked up near Scott's Bluff, Nebr., at a point near the southeastern corner of what is now Wyoming. As this specimen was preserved and is the only specimen mentioned in the narrative, it may well be the type of Bachman's *borealis*. As Richardson two years earlier applied the name *borealis* to another species (*talpoides*), Bachman's name has no standing in this connection. The fact that Richardson had identified this specimen as his *borealis*, and on it had drawn up a full description which was used by Bachman, does not make available the name which was already a synonym of *talpoides*.

Measurements.—Topotype (♂ ad.): Total length, 205; tail vertebræ, 66; hind foot, 28.5. Average of 7 female topotypes: 204, 60, 27. *Skull* (topotype, ♂ ad.):[1] Basal length, 33.4; nasals, 13; zygomatic breadth, 22; mastoid breadth, 19.5; interorbital breadth, 11.5: alveolar length of upper molar series, 7.

Remarks.—In general appearance *clusius* is nearer *talpoides* than is the larger and paler *bullatus,* which separates their ranges and evidently grades into one on the north and the other on the south. It is not improbable, however, that *clusius* and *talpoides* meet in a narrow Transition Zone strip along the eastern base of the Rocky Mountains above the Upper Sonoran limits of *bullatus.* At the type locality and over most of its range *clusius* is found in Transition Zone sage-brush country.

Specimens examined.—Total number, 106, as follows:

Colorado: Avalo, 5; Boulder, 1; Canadian Creek (North Park), 6; Colorado Springs, 7; Estes Park, 1; Flagler, 7; Gold Hill, 1; Limon, 1; Pawnee Buttes, 1; Siebert (8 miles south), 1.

Wyoming: Bear Creek (3 miles southwest of Laramie Peak, at 7,500 feet altitude), 1; Beaver, 1; Bridgers Pass, 14; Casper (40 miles southwest), 4; Cheyenne, 7; Dayton, 1; Douglas, 2; Ferris Mountains (7,800 to 9,400 feet), 4; Fetterman, 1; Fort Russell, 1; Fort Steele, 3; Green Mountains (8,000 feet), 2; Islay, 2; Laramie Mountains (east of Laramie, at 8,500 and 9,000 feet), 3; Little Bear Creek (20 miles southeast of Chugwater), 1; Miners Delight, 1; Myersville, 2; Myersville (22 miles southeast), 1; Pass (now Parkman), 2; Pine Bluffs, 2; Rattlesnake Mountains (north base), 3; Rawhide Butte (5,400 feet), 1; Red Bank, 1; Rock Creek, 1; Sherman, 2; Shirley Mountains (7,600 to 8,800 feet), 4; Springhill (12 miles north of Laramie Peak), 2; Sun, 3; Wheatland (15 miles southwest, at 5,200 feet), 1; Woods, 2.

THOMOMYS TALPOIDES BULLATUS Bailey.

SAGE POCKET GOPHER.

(Pl. VII, fig. 2.)

Thomomys talpoides bullatus Bailey, Proc. Biol. Soc. Washington, XXVII, 115, July 10, 1914.

Type.—Collected at Powderville, Custer County, Montana, by Dr. A. K. Fisher, July 21, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Plains of eastern Montana, northeastern Wyoming, and western South Dakota; north to Medicine Hat, Alberta (fig. 10).

Characters.—Size of *talpoides,* but with larger audital bullæ, lighter dentition, and brighter colors; mammæ usually in 6 pairs; young, 5 to 7.

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[1] No. 25534, U. S. Nat. Mus.

Color.—*Summer pelage:* Practically the same as in *clusius*, with less gray on cheeks; upperparts light buffy- or hazel-gray, brightest on crown; ear patch blackish; underparts buffy, sometimes with white on chin; feet and tail whitish. *Winter pelage* (November specimen, from Fort Custer): Upperparts much paler, light buffy gray; underparts creamy white.

Skull.—Size and general form nearly as in *talpoides*, but less ridged and with smaller molars, much larger and more rounded bullæ, and narrower anterior shaft of basioccipital.

Measurements.—Type (♂ ad.): Total length, 238; tail vertebræ, 72; hind foot, 30. Male topotype: 242, 76, 30; female topotype: 225, 78, 29. *Skull* (of type): Basal length, 37.6; nasals, 15.5; zygomatic breadth, 24; mastoid breadth, 20.3; interorbital breadth, 6.5; alveolar length of upper molar series, 8.

Remarks.—This is a pale Upper Sonoran form, not entirely intermediate between *talpoides* and *clusius*, both of which are Transition Zone forms (one of the humid grass-prairies, the other of arid sagebrush). To some extent *bullatus* combines the characters of both, but is not quite intermediate and has a well-defined range. The beautiful series of specimens from Medicine Hat, Alberta, mainly immature females, are in the light gray, early winter coat. They are provisionally placed with this form until better characters can be observed from skulls of adult males and from summer skins.

Specimens examined.—Total number, 82, as follows:

Alberta: Medicine Hat, 10 (not typical).

Montana: Alzada, 1; Cedar Creek (15 miles north of Terry), 3; Darnalls (on south bank Missouri River south of Glasgow), 1; Fort Assiniboine, 4; Fort Custer, 6; Fort Thorne, 1; Johnson Lake, 2; Piney Buttes, 2; Powderville, 4; Red Lodge, 1; Terry, 1.

North Dakota: Buford, 4; Yellowstone River (mouth), 1.

South Dakota: Buffalo Gap, 3; Corral Draw (Pine Ridge Indian Reservation), 4; Crow Buttes (Harding County), 1; Elk Mountain, 10; Fort Meade, 1; Rapid City, 2; Smithville, 2.

Wyoming: Clearmont, 1; Devils Tower, 1; Ishawooa Creek, 4; Moorcroft, 3; Newcastle, 5; Powder River crossing, 2; Sage Creek (west of Fort Washakie), 1; Wind River (north of Washakie), 1.

THOMOMYS TALPOIDES NEBULOSUS BAILEY.

BLACK HILLS POCKET GOPHER.

(Pl. VII, fig. 3.)

Thomomys talpoides nebulosus Bailey, Proc. Biol. Soc. Washington, XXVII, 116, July 10, 1914.

Type.—Collected in Sand Creek Canyon, Black Hills, Wyoming (at Jack Boyden's ranch, 5 miles above mouth of Canyon, at 3,750 feet altitude), by Vernon Bailey, August 25, 1913. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Black Hills, S. Dak., and Bear Lodge Mountains, Wyo. (fig. 10).

Characters.—Size of *talpoides;* color more brownish gray; skull slender, lightly ridged; dentition light; bullæ well rounded; not very different externally from *fossor*, but mammæ in 6 pairs, inguinal 2-2, abdominal 2–2, pectoral 2–2.

Color.—*Summer pelage* (July and August): Upperparts dull grayish brown; nose plumbeous or dusky; ear patch blackish; underparts buffy, generally with white on chin and sometimes on breast; feet and tail whitish gray or buffy. *Winter pelage* (held over in April specimens from Redfern, S. Dak.): Dark buffy gray, darker than in similar coat of *talpoides*, not so rufescent as in *fossor;* underparts light buff. *Young* (half-grown July specimen from Custer, S. Dak.): Dull and dark, as in *talpoides.*

Skull.—Larger and more heavily ridged than in *talpoides* but less heavily ridged than in *rufescens;* temporal ridges parallel in adults, and interparietal triangular; audital bullæ full and well rounded but not so large as in *bullatus;* basioccipital slender. *Dentition* conspicuously light. Compared with *fossor*, the skull is larger, relatively wider, and more robust.

Measurements.—Type: Total length, 230; tail vertebræ, 66; hind foot, approximately 32 (27 without toenails). Average of 4 female topotypes: 226, 65, 31.5. *Skull* (of type): Basal length, 37.7; nasals, 14.3; zygomatic breadth, 24.3; mastoid breadth, 20; interorbital breadth, 6.5; alveolar length of upper molar series, 7.7.

Remarks.—This is a well-marked form of *talpoides*, occupying the higher parts of the Black Hills and Bear Lodge Mountains, and coming down in wooded canyons to the base of both ranges in the Canadian and Transition Zones. In the Bear Lodge Mountains it is less strongly differentiated from *talpoides* and shows a tendency toward *bullatus*, but can best be placed with the Black Hills form.

Specimens examined.—Total number, 27, as follows:

South Dakota: Beaver Creek, 1; Custer, 4; Redfern, 4; Spring Creek, 1; Tigerville, 2.

Wyoming: Bear Lodge Mountains (at 6,000 and 6,200 feet altitude), 6; Rattlesnake Creek (head, at 6,000 feet in the Black Hills), 2; Sand Creek Canyon, 5; Sundance (in canyon at base of Bear Lodge Mountains), 2.

THOMOMYS TALPOIDES CARYI BAILEY.

BIGHORN POCKET GOPHER.

(Pl. VII, fig. 6.)

Thomomys talpoides caryi Bailey, Proc. Biol. Soc. Washington, XXVII, p. 115, July 10, 1914.

Type.—Collected at head of Trapper Creek, at 9,500 feet altitude, in the Bighorn Mountains, Wyoming, by Merritt Cary, July 10, 1910. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Canadian Zone on Bighorn Mountains, Wyo. (fig. 10).

Characters.—Size about the same as *clusius* or slightly smaller; color darker, more rufescent, without gray cheeks and sides; skull with smaller bullæ and wider interparietal; mammæ in 6 pairs.

Color.—*Summer pelage* (September): Upperparts warm grayish brown, with plumbeous nose and black ear patch; underparts rich buffy with white on chin and sometimes on breast; feet soiled whitish; tail gray or buffy with whitish tip. *Winter pelage* (on rump of type, June 10): Dark buffy gray, underparts creamy.

Skull.—General form similar to that of *clusius* but with shorter, wider interparietal, slightly smaller bullæ, and generally wider and more emarginate nasals.

Measurements.—Type (♀ young ad.): Total length, 196; tail vertebræ, 54; hind foot, 26. Topotype (♀ more fully ad.): 203, 58, 28. *Skull* (of type): Basal length, 32.5; nasals, 12; zygomatic breadth, 20.5; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 6.2.

Remarks.—This form is poorly represented, but shows characters that exclude it from any of the neighboring forms. Externally it most closely resembles the Black Hills gopher, but in cranial characters stands nearest to *clusius*; of which it may be considered a dark-colored mountain race. A good series of specimens including adult males from the high central area of the Bighorn Mountains will doubtless show more pronounced characters. The details of the distribution of the form remain to be worked out. The specimens examined are all females and from the Canadian Zone.

Specimens examined.—Total number, 4, as follows:

Wyoming: Bighorn Mountains (9,000 and 9,500 feet altitude, in central part), 2; Bighorn Mountains (8,400 and 9,000 feet, in southern part), 2.

THOMOMYS TALPOIDES PRYORI BAILEY.

PRYOR MOUNTAIN POCKET GOPHER.

(Pl. VII, fig. 7.)

Thomomys pryori Bailey, Proc. Biol. Soc. Washington, XXVII, 116, July 10, 1914.

Type.—Collected on Pryor Mountains, Montana, at head of Sage Creek (6,000 feet altitude), by Vernon Bailey, July 16, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Pryor Mountains, Mont., east to the Bighorn River, near Fort Custer (fig. 10).

Characters.—Size of *clusius*, but darker colored and with shorter nasals and more projecting incisors; mammæ in 6 pairs, inguinal 2–2, abdominal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts dull walnut-brown, about as in *fossor;* nose plumbeous; cheeks dark gray; ear patch black;

underparts dark buff with no trace of white in topotype series; feet and tail soiled whitish or buffy. *Winter pelage* (as shown in long fur retained on rump of type and one topotype): More grayish brown.

Skull.—Low and wide, with very short and posteriorly pointed nasals; temporal ridges parallel; interparietal triangular; audital bullæ rather small; basioccipital wide between bullæ; interpterygoid fossa narrow and sharp. *Dentition* light; upper incisors strongly projecting; inner grooves not so distinct as in *talpoides.*

Measurements.—Type (♂ ad.): Total length, 210; tail vertebræ, 60; hind foot, 29. Average of 2 female topotypes: 201, 53, 28.5. *Skull* (of type): Basal length, 34; nasals, 12.5; zygomatic breadth, 22; mastoid breadth, 18.5; interorbital breadth, 5.7; alveolar length of upper molar series, 7.

Remarks.—This seems to be a very local form of the higher slopes of the Pryor Mountains, and undoubtedly grades into some of the other forms below. It seems to be distinct from *caryi*, the gopher on the Bighorn Range, from which it is separated by the deep canyon of the Bighorn River, and also from *bullatus*, from which it is separated at Fort Custer by the river. The shallow, slender rostrum and arrangement of mammæ place it in the *talpoides* group, but the peculiar nasals and projecting incisors are not found in any of the other forms.

Specimens examined.—Total number, 7, as follows:

Montana: Bighorn River (west side, near Fort Custer), 2; Pryor Mountains (cold slopes, edge of Canadian Zone), 5.

THOMOMYS TALPOIDES AGRESTIS Merriam.

San Luis Pocket Gopher.

(Pl. VII, fig. 4.)

Thomomys talpoides agrestis Merriam, Proc. Biol. Soc. Washington, XXI, 144, June 9, 1908.

Type.—Collected at Medano Ranch (15 miles northeast of Mosca), San Luis Valley, Colorado, by Merritt Cary, October 29, 1907. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—San Luis Valley, Colo. (fig. 8).

Characters.—Decidedly larger and paler than typical *clusius;* skull heavier and more conspicuously ridged; more nearly resembling *bullatus*, but with relatively narrower skull, and larger, more pointed nasals.

Color.—*Summer pelage:* Upperparts buffy or brownish gray, richest along median line of back; ear patch blackish; nose gray; underparts buffy; chin white in two specimens; a white spot on breast in one; feet and tail whitish or buffy gray. *Winter pelage:* Upperparts lighter, more grayish; underparts whitish or creamy.

Skull.—Long and narrow, with uniformly arched outline; temporal ridges prominent and parallel in old age; nasals long and narrow, and pointed at posterior tip, with a slight expansion back of middle; interparietal triangular; auditory meatus slender; bullæ medium, not so full and rounded as in *bullatus*. *Dentition* medium; incisors bent at right angles to axis of skull.

Measurements.—Type (♀ ad.): Total length, 220; tail vertebræ, 57; hind foot, 30. Topotype (♂ not fully ad.): 205, 50, 30. *Skull* (of type): Basal length, 38; nasals, 15; zygomatic breadth, 23.5; mastoid breadth, 19.7; interorbital breadth, 6.5; alveolar length of upper molar series, 8.

Remarks.—This is a well-marked local form of the *talpoides* group occupying the great arid San Luis Valley, in open sage brush of the Transition Zone. At present it may be isolated from other forms of the group except *fossor*, by which it is surrounded in the timbered mountains and from which it may have been derived. More probably, however, it is a more recent derivative of *clusius* which has entered the valley through one of the passes.

Specimens examined.—Total number, 18, as follows:

Colorado: Blanco, 1; Creston, 1; Fort Garland, 2; Medano Ranch, 5; Saguache (12 miles northwest), 1; San Acacia, 8.

THOMOMYS COLUMBIANUS BAILEY.

COLUMBIA POCKET GOPHER.

(Pl. VII, fig. 12.)

Thomomys fuscus columbianus Bailey, Proc. Biol. Soc. Washington, XXVII, 117, July 10, 1914.

Type.—Collected at Touchet, Walla Walla County, Washington, by Clark P. Streator, September 10, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Plains of southeastern Washington and northern Oregon (fig. 5).

Characters.—Size slightly smaller than *talpoides*, slightly larger than *quadratus*, colors paler than either, about as in *fisheri;* skull heavier than in *quadratus;* claws moderately stout; mammæ in 6 pairs, inguinal 2–2, abdominal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts light wood brown or buffy gray; sides and belly pale buffy gray; ear and postauricular patch black; nose slaty; tail gray with white tip; feet whitish. *Winter pelage* slightly grayer. *Young* very gray.

Skull.—Smaller than that of *talpoides*, with shorter, wider nasals; larger and longer than that of *quadratus*, rather heavy and angular; lateral ridges well developed in adults, approximately parallel; bullæ large and rounded, widening base of skull and narrowing shaft of basioccipital; interparietal more or less triangular.

Measurements.—Type (♂ ad.): Total length, 209; tail vertebræ, 60; hind foot, 28. Topotype (♀ ad.): 208, 68, 27. *Skull* (of type): Basal length, 34; nasals, 13; zygomatic breadth, 22.7; mastoid breadth, 18.7; alveolar length of upper molar series, 8.

Remarks.—The relationships of this form are doubtful. In many respects it resembles the *talpoides* group, especially in arrangement of mammæ and in general skull characters. In small ears and rather square-built skull it seems close to *quadratus*, and there is some question whether along the borders of its range it does not interbreed with both *quadratus* and *fuscus*. Two young females from Asotin, Wash., are probably typical of *columbianus*, but are too young to afford reliable characters. An old male from Willows Junction, Oreg., is very small, but is provisionally referred to *columbianus*.

Specimens examined.—Total number, 37, as follows:

Oregon: Pendleton, 4; Umatilla, 9; Willows Junction, 1.

Washington: Asotin, 2; Baird, 9; Fort Walla Walla, 3; Prescott, 4; Touchet, 4; Wallula, 1.

THOMOMYS OCIUS MERRIAM.

GREEN RIVER POCKET GOPHER.

(Pl. II, fig. 12; Pl. VII, fig. 9.)

Thomomys clusius ocius Merriam, Proc. Biol. Soc. Washington, XIV, 114, July 19, 1901.

Type.—Collected near Old Fort Bridger, Wyoming (exact locality, dry sagebrush mesas at Harvey's Ranch, on Smiths Fork, 6 miles southwest of Fort Bridger), by Vernon Bailey, May 24, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Green River Basin of southwestern Wyoming, northwestern Colorado, and northeastern Utah (fig. 10).

Characters.—Size small; color very pale; skull slender, with very large and rounded audital bullæ and sharply incurved upper incisors; ears very small but pointed; mammæ normally in 7 pairs, inguinal 2–2, abdominal 2–2, pectoral 3–3.

Color.—*Summer pelage:* Upperparts light buffy gray, more strongly buffy or tinged with brownish on crown and back; sides clear gray; cheeks darker gray; ear patch blackish but small; underparts, feet, and tail soiled whitish or creamy. *Winter pelage:* Upperparts lighter buffy gray; nose and cheeks clearer gray; underparts whitish or creamy.

Skull.—Rather narrow, with slightly arched dorsal outline; interparietal short and wide; temporal ridges slightly converging anteriorly; posterior tips of nasals rounded; audital bullæ very large and smoothly rounded, with anterior arm of basioccipital slender and narrow between them. *Dentition:* Upper incisors sharply incurved so that the cranium can be readily suspended by them, and lower incisors also curved very abruptly upward.

Measurements.—Type (a large old male): Total length, 204; tail vertebræ, 60; hind foot, 26. Topotype (♂ ad.): 188, 51, 24. Average of 6 topotypes (♀ ad.): 194, 58, 24.6. *Ear:* From crown, measured in flesh, 5. *Skull* (of type): Basal length, 33; nasals, 12; zygomatic breadth, 20; mastoid breadth, 17; interorbital breadth, 5.5; alveolar length of upper molar series, 7.

Remarks.—This is a little, pale, desert species of the Green River Basin, mainly in the Upper Sonoran Zone. It occupies the dry, sagebrush mesas, while *bridgeri* occupies the fertile valleys close by. Fort Bridger seems to be the extreme upper limit of *ocius*, and here its range meets that of the much larger *bridgeri* and almost or quite meets that of the smaller, darker-colored *pygmæus*. On the east it meets the range of *clusius*, but I find no signs of intergradation, and the skull characters are so stronglv marked that it seems best to treat *ocius* as a full species. Its nearest relatives are *idahoensis* of southern Idaho, and more remotely the little *pygmæus*, along its western border in the Transition Zone. These three forms are the only members of the genus in which the crania can be readily suspended by hooking the upper incisors over a wire or string. The ears of *ocius* are very small, measuring uniformly 5 mm. from posterior base to tip in fresh specimens, while in *bridgeri* from the same locality they measure 8 mm. The females have normally 14 mammæ and contained 7 fetuses, contrasted with 10 mammæ and 5 fetuses in *bridgeri*, collected at the same time and place.

Specimens examined.—Total number, 38, as follows:

Colorado: Douglas Spring, 1; Ladore, 2; Lay, 1; Lily, 2; Rangely, 2; Snake River (20 miles west of Baggs), 2.

Utah: Uncompahgre Indian Reservation, 2.

Wyoming: Bitter Creek, 2; Eden, 1; Fontenelle, 1; Fort Bridger, 9; Green River (junction of New Fork), 3; Henrys Fork, 1; Maxon (5 miles southwest), 8; Opal, 1.

THOMOMYS IDAHOENSIS MERRIAM.

IDAHO POCKET GOPHER.

(Pl. II, fig. 7; Pl. VII, fig. 10.)

Thomomys idahoensis Merriam, Proc. Biol. Soc. Washington, XIV, 114, July 19, 1901.

Type.—Collected at Birch Creek (10 miles south of Nicholia, at about 6,400 feet altitude), Fremont County, Idaho, by Clark P. Streator, August 8, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Snake River Plains, southeastern Idaho (fig. 10).

Characters.—Size very small; color pale yellowish gray; ears small; skull light and smooth, with very large and globose bullæ and incurved upper incisors; mammæ in 6 pairs, inguinal 2–2, abdominal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts pale dull olive-buff or buffy gray; ear with only a trace of dusky patch; nose yellowish; underparts pale buff or soiled whitish, occasionally with white chin; feet and tail very hairy, pale buffy or whitish. *Young*, more ashy gray. *Winter pelage* unknown. The summer pelage is decidedly paler than the corresponding pelage of *ocius*, hence the winter pelage is probably lighter colored than in any other northern species of the genus.

Skull.—Of much the same general form as in *ocius*, but conspicuously smaller and smoother with smaller, more oval interparietal; nasals minutely notched at posterior tip and ending approximately even with premaxillæ; audital bullæ very large and globose, sometimes actually meeting over narrow shaft of basioccipital. While the external ear is very small, the auditory meatus and audital bullæ are unusually developed, the bullæ being relatively the largest of any species of the genus.

Measurements.—Type (♂ ad.): Total length, 179; tail vertebræ, 47; hind foot, 23. Average of 10 male topotypes: 179, 50, 22.5. Average of 9 female topotypes: 166, 49, 22.4. *Ear*, from base, measured in flesh, 4.5. *Skull* (of type): Basal length, 29.5; nasals, 11.5; zygomatic breadth, 18; mastoid breadth, 16; interorbital breadth, 4.7; alveolar length of upper molar series, 5.5.

Remarks.—The type locality is at the extreme upper edge of the Upper Sonoran Zone and the upper limit of the range of the species. This gopher is a small, pale, desert species of the Snake River Plains. There is no indication of its intergradation with any of the surrounding forms, and its nearest relative is *ocius* of the upper Green River Basin in Wyoming. The boundary of its range remains to be worked out, and winter or early spring specimens are greatly needed to show the winter pelage.

Specimens examined.—Total number, 42, as follows:

Idaho: Big Butte, 2; Big Lost River (near Sink), 3; Birch Creek (10 miles south of Nicholia, 6,400 feet altitude), 21; Blackfoot, 11; Dubois, 1; Idaho Falls, 1; Sink of Birch Creek (5,100 feet), 3.

THOMOMYS PYGMÆUS MERRIAM.

PYGMY POCKET GOPHER.

(Pl. VII, fig. 11.)

Thomomys pygmæus Merriam, Proc. Biol. Soc. Washington, XIV, 115, July 19, 1901.

Type.—Collected at Montpelier Creek (exact locality about 10 miles northeast of Montpelier, at 6,600 feet altitude, in open sagebrush of

Transition Zone), Bear County, Idaho, by Vernon Bailey, July 29, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Southwestern Wyoming and southeastern Idaho (Transition Zone) (fig. 10).

Characters.—Size smallest of the genus; color rich hazel-brown; skull very slender and delicate with not very large audital bullæ; upper incisors incurved, distinctly grooved; ears small; mammæ in 6 pairs, inguinal 2–2, abdominal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts rich hazel-brown, very uniformly distributed; dusky earpatches inconspicuous; nose plumbeous; underparts dull ochraceous, rarely with any white markings; tail usually entirely buffy gray; feet whitish or buffy. *Winter pelage:* Paler, more buffy brown. *Young:* Duller, more grayish and with lighter-colored belly.

Skull.—Very small, slender, and thin, the slight trace of temporal ridges converging anteriorly; interparietal wide and oval; nasals notched or emarginate at posterior tip; bullæ rather small; auditory meatus slender; interpterygoid fossa narrow and acute angled; basioccipital narrow. *Dentition* very light; upper incisors incurved to a slightly less degree than in *ocius* and *idahoensis*.

Measurements.—Type (♂ ad.): Total length, 177; tail vertebræ, 46; hind foot, 22. Topotype (♂ ad.): 165, 40, 20. Specimen from Bear River (♀ ad.): 168, 50, 23. *Skull* (of type): Basal length, 28.4; nasals, 10.4; zygomatic breath, 16.5; mastoid breadth, 14.5; interorbital breadth, 5; alveolar length of upper molar series, 6.

Remarks.—This, the smallest of all known pocket gophers, seems not to be closely related to any of the neighboring forms nor to intergrade with them. It has some of the skull characters of *fuscus*, but seems to be more nearly related to *idahoensis* and *ocius*, from which, however, it is quite distinct. It occurs in the same localities but apparently not on the same ground with the much larger *bridgeri* and *uinta*, occupying the Transition Zone sagebrush ridges and mesas, while they are restricted to the mellow soil and more fertile bottoms of the stream valleys. A specimen in the Academy of Natural Sciences of Philadelphia (No. 144), collected by J. K. Townsend in 1834, probably came from the Bear River region, but was later labeled "Columbia River."

Specimens examined.—Total number, 23, as follows:

Idaho: Montpelier Creek (12 miles northeast of Montpelier at 6,700 feet altitude), 2.

Wyoming: Bear River and Bear River Divide (14 miles north of Evanston at 6,600–7,500 feet), 12; Big Piney (6,400 feet), 1; Big Sandy, 1; Fossil (6,600 feet), 1; Lone Tree (5 miles west, on Henry Fork, 7,400 feet), 2; Merna (on Horse Creek, 7,800–8,000 feet), 3; Surveyors Park (12 miles northeast of Pinedale, 8,000 feet), 1.

Thomomys fossor Group.

THOMOMYS FOSSOR ALLEN.

COLORADO POCKET GOPHER.

(Pl. II, fig. 8; Pl. VII, fig. 13; text fig. 4.)

Thomomys fossor Allen, Bul. Am. Mus. Nat. Hist. V, 51, April 28, 1893.

Type.—Collected at Florida, La Plata County, Colorado, altitude 7,200 feet, by Charles P. Rowley, June 25, 1892. Type specimen in Am. Mus. Nat. Hist.

Distribution.—Mountains of western Colorado, extreme southern Wyoming, northern New Mexico, eastern and southern Utah, and northwestern Arizona (fig. 8).

Characters.—Size medium, hind foot averaging about 29 mm.; color dull and dark brown; ears large; skull long, low, and narrow, with rostrum especially slender in profile, as in the *talpoides* group; mammæ in 5 pairs, inguinal 2–2, pectoral 3–3.

Color.—*Summer pelage:* Upperparts dull dark brown with sometimes a rich chestnut tone; ear and postauricular patch black; nose and face dusky; underparts buffy or ochraceous; part of feet and tip of tail usually whitish; chin usually, and spot on breast sometimes, white. *Winter pelage:* Duller, more grayish or drab. *Young:* In summer paler and more buffy than adults.

Skull.—Long and slender, with long rostrum, and anteriorally converging temporal ridges; nasals narrow, with generally rounded posterior tips; interparietal triangular; bullæ large and full, basioccipital narrowed between them. *Dentition* very light.

Measurements.—Average of 4 female topotypes: Total length, 221; tail vertebræ, 63; hind foot, 29. A large male measures 220, 68, 32. *Skull* (of type, ♂ ad.): Basal length, 37; nasals, 15; zygomatic breadth, 22; mastoid breadth, 20; alveolar length of upper molar series, 7.5. Skull of adult male from Lake City, Colo.:[1] 34, 13.5, 21, 18.7, 7.

Remarks.—This is a wide-ranging boreal species with long, soft fur, which even in midsummer does not become so short and harsh as in low-country species. At high altitudes the long coat seems not to be entirely lost during the brief summer.

As might be expected there is some slight variation in specimens from different mountain ranges, some of which are entirely isolated by low country, but nowhere is there enough variation to warrant further subdivision. In such a variable group it is a great satisfaction to find an occasional species that holds its distinctive characters over a wide area.

Specimens examined.—Total number, 183, as follows:

Arizona: Bright Angel Spring (Kaibab Plateau), 3; DeMotte Park (Kaibab Plateau), 3.

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[1] No. 48190, U. S. Nat. Mus.

Colorado: Arapahoe Pass (Rabbit Ear Mountains), 5; Black Hawk, 2; Baxter Pass (Book Plateau), 2; Boulder (5 miles west, at 5,600 feet altitude), 7; Cascade, 1; Cochetope Pass (3 miles east), 5; Colorado City, 1; Colorado Springs (2½ miles north, at 6,000 feet), 1; Colorado Springs (east of Palmer Park), 1; Como, 1; Coulter, 3; Crested Butte, 4; Culebra Canyon (Costilla County), 1; Elk Head Mountains, 2; Elkhorn, 1; Estes Park, 6; Florida, 5; Golden, 2; Hahns Peak, 2; Hayden, 1; Lake City, 2; Longs Peak, 3; Meeker, 3; Montgomery, 3; Nederland, 4; Pagosa Springs, 3; Pagosa Peak, 1; Pearl, 1; Saguache (23 miles northwest), 1; Sapinero, 2; Silverton, 2; Uncompahgre Plateau, 2; Teller County Divide, 1; White River Plateau, 1.

New Mexico: Chusca Mountains, 3; Costilla Pass, 5; Costilla River, 3; Gallinas Mountains (Rio Arriba County), 7; Halls Peak, 1; Hondo Canyon, 1; Hopewell, 6; Horse Lake, 6; Jemez Mountains (head of Santa Clara Creek), 5; Moreno Valley, 2; Mount Taylor, 1; Pecos Baldy, 4; Red River (Taos County), 4; Taos Mountains, 4; Tres Piedras, 1; Tusas River, 1; Twining, 12; Whites Peak, 1; Willis, 4.

Utah: Beaver Mountains, 9; Buckskin Valley, 1; Fish Lake, 4; La Sal Mountains, 1; Panguich Lake, 1; Parawan Mountains, 4.

Wyoming: Bridgers Peak (8,800 feet altitude), 3; Medicine Bow Mountains (10,200 feet), 1.

THOMOMYS BRIDGERI MERRIAM.

FORT BRIDGER POCKET GOPHER.

(Pl. VII, fig. 15.)

Thomomys bridgeri Merriam, Proc. Biol. Soc. Washington, XIV, 113, July 19, 1901.

Type.—Collected at Fort Bridger, Wyoming (exact locality, Harvey's Ranch on Smiths Fork, 6 miles southwest of Old Fort Bridger), by Vernon Bailey, May 27, 1890. Type specimen in U. S. Nat. Mus., Merriam collection.

Distribution.—Southwestern Wyoming and southeastern Idaho (Transition Zone) (fig. 5).

Characters.—Size large; ears large and prominent; color dull dark brown; skull heavily ridged and angular, with deeply emarginate nasals; mammæ in 5 pairs, inguinal 2–2, pectoral 3–3.

Color.—*Summer pelage:* Upperparts rich warm brown, nearest to cinnamon-brown of Ridgway; nose and face dusky brown; large ear patch black; underparts dark buffy or dull ochraceous, occasionally with white patch on chin; feet partly gray or mottled with gray; toes whitish; tail brownish gray, paler below and occasionally with white tips. *Winter pelage:* Upperparts duller and darker, more nearly Prout's brown of Ridgway; nose plumbeous, ear patch black; underparts washed with buffy over light plumbeous, with almost a lavender effect. *Young* more grayish.

Skull.—Large, angular, and heavily ridged in adults; nasals long and deeply emarginate at posterior tips; temporal ridges parallel or slightly converging in middle; interparietal triangular; audital bullæ long, narrow, and wide apart, with wide shaft of basioccipital between; auditory meatus moderately large. *Dentition* relatively light; incisors very long and slightly protruding.

Measurements.—Type (♂ ad.): Total length, 237; tail vertebræ, 71; hind foot, 34. Topotype (♀ ad.): 227, 68, 31. Average of 10 adult males: 244, 72, 33.2. Average of 10 adult females: 233, 71, 31.5. *Ear:* From crown, 8. *Skull* (of type): Basal length, 39; nasals, 16; zygomatic breadth, 24.5; mastoid breadth, 22; interorbital breadth, 7; alveolar length of upper molar series, 8.

Remarks.—This big gopher is abundant in fertile valleys in the Transition Zone, but does not inhabit the arid upland. It is a strongly marked, outlying form of the *fossor* group, and its nearest relative is *uinta*. It has a lower zonal range, however, and seems to be entirely distinct. More thorough collecting may show that it grades into *uinta* higher up the streams, but at present the two are best treated as distinct species.

At the type locality females were found normally to have 10 mammæ and 5 embryos, as contrasted with the 14 mammæ and 7 embryos in the little *ocius* of the dry sagebrush mesas close by.

Specimens examined.—Total number, 74, as follows:

Idaho: Montpelier, 18; Montpelier Creek (6,000 feet altitude), 1.

Wyoming: Bear River (14 miles north of Evanston, 6,600–6,800 feet altitude), 5; Border, 1; Cokeville (6,400 feet), 8; Fort Bridger, 24; Henry's Fork (5 miles west of Lonetree), 1; Lonetree (7,400 feet), 3; Lonetree (4 miles south), 2; Mountain View, 11.

THOMOMYS UINTA MERRIAM.

UINTA POCKET GOPHER.

(Pl. VII, fig. 14.)

Thomomys uinta Merriam, Proc. Biol. Soc. Washington, XIV, 112, July 19, 1901.

Type.—Collected in Uinta Mountains (10,000 feet altitude, north base of Gilbert Peak), Summit County, Utah, by Vernon Bailey, June 6, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Western Wyoming, southeastern Idaho, and northern Utah (fig. 5).

Characters.—About the size of *fossor* and practically indistinguishable in external characters; skull shorter and wider, with shorter rostrum and heavier dentition; mammæ in 5 pairs, inguinal 2–2, pectoral 3–3.

Color.—*Summer pelage:* Upperparts dull dark brown, with dusky nose and face and blackish ear and ear patch; underparts buffy or ochraceous, with occasionally a white patch on chin; feet and tip of tail usually whitish. *Late fall and winter pelage:* Duller and more grayish. *Young,* paler, more buffy than adults.

Skull.—Heavier and wider than in *fossor*, with heavier dentition, smaller bullæ, a more nearly five-angled interparietal, and wider nasals with deeply emarginate instead of rounded posterior tips.

Measurements.—Average of type and topotype (♂ ad.): Total length, 226; tail vertebræ, 70; hind foot, 31. Topotype (♀ ad.): 211, 64, 28. *Skull* (of type): Basal length, 35; nasals, 13; zygomatic breadth, 23; mastoid breadth, 21; alveolar length of upper molar series, 8.

Remarks.—While very similar to its nearest relative, *fossor*, in external characters, *uinta* has such pronounced skull characters and is so widely separated that it is best treated as a full species. It also has the same boreal, mountain habitat and practically the same environment and habits as *fossor*. Specimens from the mountains of western Wyoming show some local variation but not sufficient to be recognized as a subspecies. There seems to be no evidence of intergradation with the smaller and smaller-eared *fuscus* group, although they come close together in the region south of Jackson Hole, Wyo.

Specimens examined.—Total number 110, as follows:

Idaho: Albion, 5; Blackfoot (hills east of town), 1; Bridge, 1; Inkom, 12; Irwin (10 miles southeast), 7; Malade, 6; Pocatello, 4; Preuss Mountains, 5; Shelley, 3; Swan Lake, 4.

Utah: Kelton (mountains 7 miles north), 3; Ogden, 6; Park City, 3; Parley Canyon, 1; Uinta Mountains (9,000–10,000 feet altitude), 6.

Wyoming: Afton, 7; Afton (10 miles southeast, in Salt River Mountains), 6; Afton (10 miles north on Salt River), 7; Black Rock Creek (head, in Shoshone Mountains), 5; Kendall (12 miles north), 6; Merna, 6; Needle Mountain (10,000 feet altitude), 4; Stanley (3 miles west), 1; Thayne, 1.

THOMOMYS QUADRATUS QUADRATUS MERRIAM.

DALLES POCKET GOPHER.

(Pl. VII, fig. 8.)

Thomomys quadratus Merriam, Proc. Biol. Soc. Washington, XI, 214, July 15, 1897.

Type.—Collected at The Dalles, Oregon, by Clark P. Streator, November 2, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Plains of eastern and central Oregon, northeastern California, and northwestern Nevada (fig. 5).

Characters.—Smaller than *uinta;* rather brighter colored; ears small; skull relatively short and wide, with wide, truncate, posterior tip of nasals; mammæ in 5 pairs, inguinal 2–2, pectoral 3–3.

Color.—*Summer pelage:* Upperparts light russet; ear patch black; nose dark plumbeous; underparts washed with dark buff; tail brownish above, except at tip; feet whitish. *Winter pelage:* Duller and grayer. *Young,* dull and rather dark.

Skull.—Relatively short and rectangular, with parallel lateral ridges, and rectangular zygomatic arches; nasals short and posteriorly truncate; pterygoids V-shaped; interparietal small, rounded, triangular, or cordate; bullæ rather small.

Measurements.—Average of 3 male topotypes: Total length, 210; tail vertebræ, 64; hind foot, 27. Average of 5 female topotypes: 195, 62, 26.4. *Skull* (of type): Basal length, 36; nasals, 13.5; zygomatic breadth, 24; mastoid breadth, 19; alveolar length of upper molar series, 8.

Remarks.—This is a wide-ranging, variable form of the *fossor* group, occupying the Upper Sonoran plains of eastern and central Oregon, northeastern California, and northern Nevada, and extending higher up in some of the narrow desert ranges.

Specimens examined.—Total number, 159, as follows:

California: Bieber, 7; Brownell, 1; Dry Creek (at 4,450 feet altitude), 1; Eagle Lake, 2; Goose Lake, 1; Goose Lake Meadows (4,800 feet), 2; Lake City, 1; Lassen Creek, 7; Madeline Divide, 1; Madeline Plains, 6; Pete's Valley, 1; Secret Valley, 1; Sugar Hill (Modoc County, 5,000 feet), 1; Susanville (4 miles south), 2; Warner Mountains (head of Parker Creek, 7,300 feet), 16; Warner Mountains (Parker Creek, 5,500 feet), 13; Warner Peak (east slope, 8,700 feet), 3.

Nevada: Badger, 1.

Oregon: Adel, 4; Crooked River, 3; Fremont, 4; Harney, 2; Ironside (4,000 feet altitude), 11; Lake Alvord, 1; Lakeview, 4; Matoleus River, 2; Merrill, 2; Mount Warner, 1; Shirk, 17; Silver Lake, 6; The Dalles, 21; Tumtum Lake, 1; Wapinitia, 1.

Washington: Rockland, 12.

THOMOMYS QUADRATUS FISHERI MERRIAM.

FISHER POCKET GOPHER.

(Pl. VII, fig. 16; text fig. 3.)

Thomomys fuscus fisheri Merriam, Proc. Biol. Soc. Washington, XIV, 111, July 19, 1901.

Type.—Collected at Beckwith, Sierra Valley, Plumas County, California, by W. K. Fisher, August 3, 1900. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Northern, central, and western Nevada; west in California to Sierra Valley and Mono Lake (fig. 6).

Characters.—Slightly smaller than *quadratus*, shorter-tailed, and paler; smaller than *clusius*, about the same color but with narrower skull and smaller bullæ; much larger than *idahoensis* with relatively smaller bullæ; claws moderately stout; mammæ in 5 pairs, inguinal 2–2, pectoral 3–3.

Color.—*Summer pelage:* Upperparts buffy gray, lightly washed with dull russet over back; ear patch blackish; nose plumbeous; underparts buffy; chin white; feet whitish; tail whitish below, gray above usually to the tip. *Winter pelage:* Slightly grayer. *Young,* more buffy.

Skull.—More like that of *quadratus* than of *fuscus* or *monticola;* lateral ridges parallel in adults; nasals truncate posteriorly; interparietal broadly triangular. *Dentition* lighter, and incisors less abruptly decurved than in *quadratus, fuscus,* or *monticola.*

Measurements.—Average of 3 topotypes (♂ ad.): Total length, 191; tail vertebræ, 58; hind foot, 25.3. Average of 3 adult females: 194, 58, 25. *Skull* (of type, ♂ ad.): Basal length, 31; nasals, 11; zygomatic breadth, 20; mastoid breadth, 17.5; alveolar length of upper molar series, 6.

Remarks.—The subspecies *fisheri* is typical only along the western part of its range. In central Nevada it is darker and perhaps grades into *uinta.* In northwestern Nevada it grades imperceptibly into *quadratus,* the only form with which it seems to be closely connected. It is quite distinct from *monticola,* with which it occurs at the type locality, and from which it differs in much smaller ears and paler color.

Specimens examined.—Total number, 97, as follows:

California: Beckwith, 1; Casa Diablo, 6; Mono Lake, 8; Sierra Valley, 8.

Nevada: Arc Dome, 2; Big Creek 6; Bull Run, 2; Cottonwood Range, 14; Eureka, 3; Monitor Mountains, 2; Mount Siegel, 2; Mount Sugar, 6; Pine Forest Range, 4; Reese River Valley (50 miles south of Austin), 9; Reno, 6; Ruby Lake, 3; Ruby Mountains, 2; Silver Creek (north of Austin), 5; Summit Lake, 3; Verdi, 3; Wells, 2.

Thomomys douglasi Group.

THOMOMYS DOUGLASI DOUGLASI (RICHARDSON).

DOUGLAS POCKET GOPHER; COLUMBIA SAND RAT.

(Pl. II, fig. 10; Pl. VIII, fig. 5.)

Geomys douglasii Richardson, Fauna Boreali-Americana, I, 200, 1829.

Geomys fuliginosus Schinz, Syn. Mamm., II, 136, 1845. "Habitat ad fluvium Columbia."

Thomomys douglasii Allen, Bul. Am. Mus. Nat. Hist., V, 66, April 28, 1893.

Type.—Collected "near the mouth of the Columbia," at Fort Vancouver, Washington, by David Douglas, probably in 1825. Mr. Oldfield Thomas writes that it is not now in the British Museum collection.

Distribution.—Known only from type locality (fig. 5).

Characters.—Size medium; claws stout; ears medium with rounded tips; color nearly uniform dull hazel without dark ear patch; skull long and slender and flat on top; incisors abruptly decurved and distinctly grooved; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—(*June specimens* from type locality): Upperparts uniform dull hazel, slightly paler on sides; underparts more ochraceous, with a white spot on breast in all of the topotypes; nose gray; feet and tail soiled whitish. *Winter and young pelages* not seen.

Skull.—Long and narrow, somewhat of the *monticola* type, but with heavier rostrum, wider interorbital constriction, and with zygomatic arches conspicuously widest at anterior angle; interparietal very small and transversely oval; bullæ small and narrow; basioccipital triangular; pterygoids low and U-shaped.

Measurements.—Average of 3 topotypes (♂ ad.): Total length, 215; tail vertebræ, 64; hind foot, 30. Average of 4 females: 200, 58, 28.6. *Skull* (of topotype, ♂ ad.):[1] Basal length, 36; nasals, 14; zygomatic breadth, 22.5; interorbital breadth, 7; mastoid breath, 19; alveolar length of upper molar series, 7.6.

Remarks.—The well-developed ears, number and position of mammæ, general tone of coloration, and long narrow skull at first suggest *douglasi* as the type of the *monticola* group, but the heavier claws, more rounded ear tips, heavier rostrum, and wider interorbital region seem to be group characters shared only by *douglasi*, *oregonus*, *yelmensis*, *melanops*, *limosus*, and *niger*. This group of isolated forms may somewhere connect with *mazama*, which seems to be its nearest relative and neighbor, but for convenience it may be termed the *douglasi* group. With the smaller-eared, slenderer-clawed *fuscus* group, it seems less closely connected. From *quadratus* and *columbianus* it differs widely in external as well as cranial characters.

Specimens examined.—Total number, 7, as follows:

Washington: Vancouver (6 or 7 miles northeast, at Fourth Plain), 7.[2]

THOMOMYS DOUGLASI OREGONUS MERRIAM.

OREGON POCKET GOPHER.

(Pl. VIII, fig. 8.)

Thomomys douglasi oregonus Merriam, Proc. Biol. Soc. Washington, XIV, 115, July 19, 1901.

Type.—Collected at Ely, near Oregon City, Oregon (exact locality in Ely's orchard), by Clark P. Streator, October 24, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 5).

Characters.—Size about as in *douglasi*; ears smaller, but of the same rounded form; color brighter hazel; skull relatively shorter and wider, with distinctly triangular interparietal; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—October specimens in thin summer pelage: Upperparts clear bright hazel, with dusky nose and cheeks and blackish ear patch;

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[1] No. 65929, U. S. Nat. Mus.

[2] Collected by Clark P. Streator, June 15–16, 1894.

underparts paler, more ochraceous; feet and tail soiled whitish. *Young* of the year, paler, more yellowish. A trace of long, rough fur on the rumps of several breeding females is duller and darker, more like the June pelage of *douglasi*.

Skull.—Relatively shorter and wider than in *douglasi*, with more-spreading and more nearly parallel zygomatic arches, triangular interparietal, larger bullæ, V-shaped instead of U-shaped interpterygoid fossa, and heavier molars; nasals narrow, with generally double rounded posterior tips.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 216; tail vertebræ, 67; hind foot, 29.5. Type (♂ ad.): 220, 70, 30. Average of 5 adult females: 210, 66, 28.2. *Skull* (of type): Basal length, 36; nasals, 14; zygomatic breadth, 23.7; interorbital breadth, 6.5; mastoid breadth, 19.4; alveolar length of upper molar series, 7.6.

Remarks.—The relationship between *douglasi* and *oregonus* is not very close and the question of continuity of range has not been worked out. The Columbia River probably separates their ranges, but they are near enough in characters to allow subspecific rank to show their relationship.

Specimens examined.—Twenty-eight, from type locality.

THOMOMYS DOUGLASI YELMENSIS MERRIAM.

YELM POCKET GOPHER.

(Pl. VIII, fig. 11.)

Thomomys douglasi yelmensis Merriam, Proc. Biol. Soc. Washington, XIII, 21, Jan. 31, 1899.

Type.—Collected at Tenino, Yelm Prairie, Thurston County, Washington, by Clark P. Streator, October 24, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Prairies around south end of Puget Sound, Wash. (fig. 5).

Characters.—Very similar to *douglasi*, but with more-pointed ears, duller and darker coloration, and conspicuous black ear patches; zygomatic arches not widest at anterior angle.

Color.—In faded October pelage: Upperparts dull hazel; nose and sides of face dusky; ears and large ear patches blackish; underparts buffy with irregular white patches; two specimens with white spots on breast and one with white spots on side; feet and tail white or soiled whitish. *Winter pelage* (just appearing on heads in October specimens) dark umber on crown.

Skull.—Long and low like that of *douglasi;* slightly concave interorbitally; zygomatic arches parallel or widest posteriorly; interpterygoid fossa more nearly V-shaped; nasals narrower and more deeply emarginate at posterior tips.

Measurements.—Type (♂ ad.): Total length, 222; tail vertebræ, 68; hind foot, 32. *Skull* (of type): Basal length, 35.5; nasals, 15; zygomatic breadth, 22.7; interorbital breadth, 6.6; mastoid breadth, 18; alveolar length of upper molar series, 7.7.

Remarks.—This is a well-marked form of the *douglasi* group probably not occurring beyond the margins of the Puget Sound prairies. The heavily timbered areas of western Washington and Oregon seem to exclude pocket gophers, but the scattered colonies of related forms strongly suggest a time when the valley prairies were more extensive in area, and the range of the gophers more or less continuous from Puget Sound to the Umpqua Valley. Isolated colonies have become more or less differentiated in characters. Even those from Roy, Spanway, and Steilacoom, Wash., differ to some extent from the type series from Tenino, but not sufficiently for separation.

Specimens examined.—Total number, 44, as follows:

Washington: Roy, 19; Spanway, 6; Steilacoom, 16; Tenino, 3.

THOMOMYS DOUGLASI MELANOPS MERRIAM.

BLACK-HEADED POCKET GOPHER.

(Pl. VIII, fig. 6.)

Thomomys melanops Merriam, Proc. Biol. Soc. Washington, XIII, 21, Jan. 31, 1899.

Type.—Collected at timberline at head of Soleduck River, Olympic Mountains, Clallam County, Washington, by C. Hart Merriam and Vernon Bailey, August 28, 1897. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Olympic Mountains, Wash. (fig. 5).

Characters.—About the size and color of *yelmensis*, but with more black on nose and head; ears small and pointed; skull long, with upper outline more arched than in *yelmensis* or *douglasi;* pterygoids small and wide apart.

Color.—August pelage: Upperparts dark russet, with dusky nose and face, and large black ear patches; underparts paler, more ochraceous, usually with white chin, wrists, and lining of cheek pouches; fore feet pure white; hind feet and tip of tail whitish.

Skull.—Long and well arched; lower outline of rostrum constricted; nasals long and deeply emarginate; premaxillæ wide; interparietal very small and oval or circular; bullæ narrow, and basioccipital wide between them; pterygoids high and wide apart.

Measurements.—Type (♀ ad.): Total length, 206; tail vertebræ, 63; hind foot, 27. Topotype (♀ ad.): 202, 58, 27. There are no adult males from the type locality and those from Happy Lake, Wash., are not correctly measured. *Skull* (of type): Basal length, 33; nasals, 13; zygomatic breadth, 20; mastoid breadth, 16; interorbital breadth, 6.4; alveolar length of upper molar series, 7.3. Skull of adult male from Happy Lake: 34.6; 14.3; 22; 17; 6.3; 7.

Remarks.—Only females and one young male of this form have been examined from the type locality, and in these the cranial characters are not perfectly shown. Specimens of adult male and female from Happy Lake, near the type locality, in the collection of the Field Museum, indicate a closer relationship with *yelmensis* and *douglasi* than was formerly supposed. The relationship of the form seems best indicated by considering it a subspecies of *douglasi*, although at present direct geographic connection is improbable.

Specimens examined.—Total number, 14, as follows:

Washington (Olympic Mountains): Happy Lake, 9; Soleduck River (head), 5.[1]

THOMOMYS LIMOSUS MERRIAM.

WHITE SALMON POCKET GOPHER.

(Pl. VIII, fig. 12.)

Thomomys limosus Merriam, Proc. Biol. Soc. Washington, XIV, 116, July 19, 1901.

Type.—Collected at White Salmon, gorge of the Columbia, Klickitat County, Washington, by J. Alden Loring, June 26, 1897. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 5).

Characters.—Size and proportions of *douglasi*, but darker colored and with blackish ear patch; skull shorter and wider.

Color.—June pelage: Upperparts dull chestnut, with plumbeous nose and blackish ear patches; underparts slightly paler, more ochraceous; in about half the specimens a white spot on breast; feet and tail soiled whitish. *Young:* Half-grown specimens very similar to adults, but slightly paler, and belly more buffy.

Skull.—Relatively short and wide with more arched dorsal outline and wide-spreading zygomata; nasals with emarginate, spreading, posterior tips, terminating approximately even with tips of premaxillæ; bullæ low and narrow, and anterior shaft of basioccipital correspondingly wide between them; pterygoids small, with narrow fossa.

Measurements.—Type (♂ ad.): Total length, 224; tail vertebræ, 68; hind foot, 30. Average of 3 topotypes (♂ ad.): 224, 69, 29.3. Topotype (♀ ad.): 216, 66, 27. *Skull* (of type): Basal length, 34.5; nasals, 14; zygomatic breadth, 23.5; mastoid breadth, 20; interorbital breadth, 6.2; alveolar length of upper molar series, 8.

Remarks.—While so strikingly different from *douglasi* as to require specific rank, this form is included in the *douglasi* group because of its prominent, rounded ear, heavy claws, and general skull characters

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[1] Two adult and two immature females, and one immature male.

It is in all probability an isolated form but evidently of ancestral connection with *douglasi*.

Specimens examined.—Six skins and seven skulls, from type locality.[1]

THOMOMYS NIGER Mᴇʀʀɪᴀᴍ.

Bʟᴀᴄᴋ Pᴏᴄᴋᴇᴛ Gᴏᴘʜᴇʀ.

(Pl. VIII, fig. 7.)

Thomomys niger Merriam, Proc. Biol. Soc. Washington, XIV, 117, July 19, 1901.

Type.—Collected at Seaton, near mouth of Umpqua River, Douglas County, Oregon, by J. Ellis McLellan, October 6, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Coast region of west-central Oregon (fig. 5).

Characters.—About the size of *douglasi*, to which it shows nearest relationship in its heavy claws and rounded ear; skull heavier, shorter; rostrum depressed; upper incisors curved inward; color black; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—Upperparts uniform glossy black with purple and green iridescence; underparts duller and more plumbeous; feet and distal portion of tail white. *Young*, sooty black.

Skull.—Shorter, wider, and heavier than in *douglasi*, with heavier rostrum; nasals posteriorly sulcate, with the anterior half abruptly widened, and the posterior tips sharply emarginate; interparietal small; bullæ fuller and more rounded than in *douglasi;* pterygoids thick and wide apart. *Dentition* heavier.

Measurements.—Type (♂ ad.): Total length, 225; tail vertebræ, 81; hind foot, 30. Female topotype: 214, 71, 30. *Skull* (of type): Basal length, 33.5, nasals, 14; zygomatic breadth, 22.5; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 8.

Remarks.—This is probably a dichromatic species of which as yet only specimens of the black phase have been secured. The cranial characters place it with *douglasi* in a group of related but not closely connected forms.

Specimens examined.—Total number, 22, as follows:

Oregon: Mapleton, 8; Mercer, 7; Scottsburg (2 miles east), 1 (albino);[2] Seaton, 6.

Thomomys monticola Group.

THOMOMYS MONTICOLA MONTICOLA Aʟʟᴇɴ

Cᴀʟɪꜰᴏʀɴɪᴀ Mᴏᴜɴᴛᴀɪɴ Pᴏᴄᴋᴇᴛ Gᴏᴘʜᴇʀ.

(Pl. II, figs. 9, 9′; Pl. VIII, fig. 1.)

Thomomys monticolus Allen, Bul. Am. Mus. Nat. Hist., V, 48, Apr. 28, 1893.

Type.—Collected on Mount Tallac, California, at 7,500 feet altitude, by W. W. Price, August 8, 1892. Type specimen in Am. Mus. Nat. Hist.

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[1] Collected June 26, 1897, by J. Alden Loring. Two are half-grown, the others adults.

[2] Without skull and not certainly identified.

Distribution.—Sierra Nevada of California and Nevada, from Lassen Peak south to Mammoth Pass (fig. 5).

Characters.—Size small; feet and claws very slender; ears large, thin, well formed, and pointed; skull long and slender, with anteriorly converging lateral ridges; colors dull hazel above, buffy below; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Winter pelage:* Upperparts dull hazel with blackish ear patch and plumbeous nose; underparts and feet dull buffy; tail whitish throughout or dusky above at base. *Summer pelage:* Slightly clearer, brighter tawny. *Young,* somewhat paler, more yellowish than adults.

Skull.—Long, slender, and low; rostrum slender, especially in profile, abruptly arched anterior to molars; zygomata very slender; interparietal usually transversely oval, wider than long; nasals long, slender, and slightly emarginate or doubly rounded at posterior tips, reaching near tips of premaxillæ; bullæ very small; lateral pits of palate deep. *Dentition* light; upper incisors abruptly decurved at right angles to axis of skull, not protruding beyond tip of nasals, and distinctly grooved.

Measurements.—Average of 5 adult males from Emerald Bay, near type locality: Total length, 212; tail vertebræ, 70; hind foot, 27.4. Average of 5 adult females: 209, 67, 26.4. *Skull* (of type, from original description): Basilar length, 34; greatest breadth, 22; interorbital breadth, 6; nasals, 14. Skull (of topotype, ♂ ad.):[1] Basal length, 32; nasals, 12.5; zygomatic breadth, 20; mastoid breadth, 17; interorbital breadth, 6.2; alveolar length of upper molar series, 7.

Remarks.—While most nearly related to the *fuscus* and *fossor* groups, *monticola* and the other subspecies, *mazama*, *pinetorum*, *nasicus*, and *helleri*, form a well-defined group. The typical subspecies appears to overlap the range of *fisheri* in Sierra Valley and actually to meet the ranges of other surrounding forms. It is mainly a Canadian Zone species, but locally extends into the Hudsonian and to a lesser extent down into the Transition Zone.

Specimens examined.—Total number, 360, as follows:

California: American River (head of South Fork), 2; Aspen Meadows, 2; Big Trees, 3; Bloods, 1; Blue Canyon, 8; Blue Lake, 3; Buck's Ranch, 2; Burney (12 miles west), 1; Calaveras Big Trees, 3; Carberry Ranch, 8; Cisco (Placer County), 25; Clouds Rest (near, meadow above Little Yosemite), 2; Donner, 21; Donner Lake, 3; Echo, 16; Emerald Bay, 24; Fallen Leaf Lake, 9; Gardners, 1; Gates Creek, 1; Greenville (8 miles west), 2; Hat Creek (head), 1; Heather Lake (Eldorado County), 1; Hermit Valley, 2; Hope Valley, 7; Independence Lake, 18; Independence Lake (pass west of), 1; Lassen Peak (north slope), 9; Lincoln Creek (Sierra County), 1; Little Yosemite, 2; Long Valley (Willow Ranch), 1; McCloud (12 miles northeast), 1; McKinneys, 13; Markleeville, 11; Milford, 4; Mill Creek (Mount Lassen), 2; Mokelumne River (head), 2; Mono Pass, 3; Mount Conness, 4; Mount Dana, 8; Mount Lyell, 1; Mount

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[1] No. 100274, U. S. Nat. Mus., from Camp Agassiz, on Mount Tallac.

Shasta, 26; Mount Tallac, 36; Mount Unicorn, 3; Pacific Creek, 1; Pine City (or Mammoth), 3: Pine Creek, 1; Pyramid Peak, 1; Robbins Creek (Lassen County), 1; San Joaquin River (head), 1; Sierra Valley, 9; Silver Lake, 8; Slippery Ford, 1; Sonora Pass, 4; Tallac, 1; Tenaya Lake, 2; Tuolumne Meadows, 20; Warner Creek (Mount Lassen), 1; West Walker River, 2.

Nevada: Carson, 1; Glenbrook, 7; Sugar Loaf (Douglas County), 2.

THOMOMYS MONTICOLA MAZAMA MERRIAM.

MAZAMA POCKET GOPHER.

(Pl. VIII, fig. 2.)

Thomomys mazama Merriam, Proc. Biol. Soc. Washington, XI, 214, July 15, 1897.

Type.—Collected at Anna Creek (near Crater Lake), Mount Mazama, Klamath County, Oregon, at 6,000 feet altitude, by Edward A. Preble, September 3, 1896. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Cascade and Siskiyou Mountains, Oreg., south in California to the Trinity Mountains (fig. 5).

Characters.—About the size of *monticola*, but darker and richer colored; ears nearly as large, and bullæ larger and more rounded; rostrum shorter, with less slender nasals; zygomatic arches more abruptly spreading; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts bright russet-brown; ear patch blackish; nose plumbeous; underparts rich buff or ochraceous; feet and tail whitish, tail usually gray above at base. *Winter pelage* unknown. *Young* slightly paler than adults.

Skull.—Not so long and slender as in *monticola;* nasals sharply emarginate posteriorly and more spreading anteriorly; anterior base of zygoma thin and prolonged against premaxilla. *Dentition* slightly heavier than in *monticola.*

Measurements.—Average of 4 topotypes (♂ ad.): Total length, 209; tail vertebræ, 66; hind foot, 28. Average of 4 adult females: 202, 66, 28.7. *Skull* (of type, ♂ ad.): Basal length, 35; nasals, 13; zygomatic breadth, 21; mastoid breadth, 17; interorbital breadth, 6.5; alveolar length of upper molar series, 7.5.

Remarks.—From *monticola* and *pinetorum*, *mazama* is readily distinguished by its shorter, wider, emarginate nasals and larger bullæ; from the *douglasi* group, by smaller size, slenderer skull, lighter dentition, V-shaped instead of U-shaped pterygoids, and deeper lateral pits of palate; from *quadratus,* by larger ears, slenderer skull, and emarginate nasals. It occupies the Canadian Zone and to some extent the Transition also.

Specimens examined.—Total number, 294, as follows:

California: Bear Creek (head of, Trinity County, at 6,400 feet altitude), 62; Beswick (6 miles southwest, 6,000 feet), 1; Castle Lake (Siskiyou County, 5,400 feet), 8; Coffee Creek (north fork, Trinity County, 4,500 feet), 15; Grizzly Creek (Trinity County, 6,000 feet), 2; Jackson Lake (Siskiyou County), 13; Picard (Elgin Ranch), 1; Rush Creek (head of, Siskiyou County, 6,400 feet), 63; Salmon Creek Divide (Siskiyou County), 4; Salmon River (south fork, 5,000 feet), 5; Scott River (6 miles northwest of Callahans), 8; Siskiyou Mountains (6,000–7,000 feet on White Mountain and Craggy Peak and in Studhorse Canyon), 22; Taylor Fork of Salmon River (5,000 feet), 2; Trinity Mountains (west end, 5,700 feet), 5.

Oregon: Anna Creek (Mount Mazama), 3; Ashland Peak, 2; Crater Lake (Mount Mazama), 5; Diamond Lake, 7; Fort Klamath, 13; Grizzly Peak (near Ashland), 1; McKenzie Bridge, 19; Mount Hood (west slope, 6,000 feet), 5; Mount Hood (Summit House at southern base), 5; Prospect, 1; Siskiyou Mountains, 2; Sisters (north base), 3; Three Sisters (town), 17.

THOMOMYS MONTICOLA PINETORUM MERRIAM.

YELLOW PINE POCKET GOPHER.

(Pl. VIII, fig. 3.)

Thomomys monticola pinetorum Merriam, N. Am. Fauna No. 16, 97, Oct. 28, 1899.
Thomomys monticola premaxillaris Grinnell, Univ. of Cal., Pub. Zool., XII, 312, Nov. 21, 1914. Collected on South Yolla Bolly Mountain, at 7,500 feet altitude, by G. Ferris, Aug. 6, 1913. Type specimen in Mus. Vert. Zool., Univ. of California.

Type.—Collected at Sisson, west base of Mount Shasta, California, by R. T. Fisher, September 4, 1898. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Mountains along west side of Sacramento Valley, Cal., from Sisson south to South Yolla Bolly Mountain (fig. 5).

Characters.—Very similar to *monticola*, but upperparts brighter, more golden brown; nose and cheeks conspicuously gray.

Color.—*Summer pelage:* Upperparts yellow-hazel, such as is seen in yellow-pine bark, but never in color keys; ear patch blackish; nose and cheeks conspicuously plumbeous or grayish, often extending back to or beyond ears; underparts buffy; tail and feet gray or whitish. *Winter pelage:* Slightly duller than in summer. *Young,* paler than adults.

Skull.—Similar to that of *monticola*, but with nasals more conspicuously emarginate at posterior tips, and falling 1 to 2 mm. short of tips of premaxillæ; interparietal smaller and more rounded, and lateral ridges more nearly parallel in adults.

Measurements.—Type (♂ ad.): Total length, 210; tail vertebræ, 76; hind foot, 28. Average of 5 topotypes (♀ ad.): 200, 73, 27.6. *Skull* (of type, ♂ ad.): Basal length, 33; nasals, 13; zygomatic breadth, 20; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 7.

Remarks.—In series of specimens from South Yolla Bolly Mountain [1] and from the head of Grindstone Creek, still farther south, the characters of *pinetorum* are slightly accentuated, but not sufficiently for further subdivision. Specimens from Wagon Camp are to some extent intermediate between *pinetorum* and *monticola*, while from higher up Mount Shasta they are typical of *monticola*. Others from half a mile west of Sisson distinctly approach *mazama*. Apparently *pinetorum* is a Transition Zone form extending from Sisson south through the mountains along the west side of the Sacramento Valley.

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[1] *Thomomys monticola premaxillaris* Grinnell differs from *pinetorum* in a slight accentuation of the same characters that separate that form from *monticola*. The premaxillæ extend 2 mm. back of the nasals in the type of *pinetorum*, 2½ mm. in the type of *premaxillaris*, while in *monticola* they are approximately even with it. The nasals in *premaxillaris* are decidedly narrower and more deeply emarginate than in *monticola* but very slightly more so than in *pinetorum*. The types of *premaxillaris* and *pinetorum* are indistinguishable in coloration. To recognize *premaxillaris* would seem to me to be splitting one rather poor subspecies in two.

Specimens examined.—Total number, 54, as follows:

California: Grindstone Creek (head), 5; Sisson, 9; South Yolla Bolly Mountain, 40.

THOMOMYS MONTICOLA NASICUS MERRIAM.

DESCHUTES POCKET GOPHER.

(Pl. VIII, fig. 4.)

Thomomys nasicus Merriam, Proc. Biol. Soc. Washington, XI, 216, July 16, 1897.

Type.—Collected at Farewell Bend, Deschutes River, Crook County, Oregon (west of Prineville), by Edward A. Preble, August 4, 1896. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—West-central Oregon (east of the Cascades), from Farewell Bend, Deschutes River, south to the Yamsey Mountains (fig. 5).

Characters.—Size and proportions of *monticola;* ears large and conspicuous; color slightly lighter and brighter; skull long and narrow, with long spreading nasals.

Color.—*Summer pelage:* Upperparts bright yellowish hazel with plumbeous nose and ear patches; underparts rich buff; feet, most of tail and chin usually whitish. *Winter pelage:* Duller hazel. *Young*, paler and duller colored.

Skull.—Long, with narrow braincase and long rostrum; nasals long and conspicuously widened anteriorly, almost spoon-shaped in some individuals, sharply emarginate at posterior tip; interparietal small and transversely oval; bullæ rather small.

Measurements.—Type (♂ ad.): Total length, 214; tail vertebræ, 69; hind foot, 27. *Skull* (of type): Basal length, 34.7; nasals, 15.4; zygomatic breadth, 21.5; mastoid breadth, 16.8; alveolar length of upper molar series, 7.

Remarks.—The subspecies *nasicus* seems to be a well-marked form of the *monticola* group, with skull characters placing it nearer *monticola* (from which it is widely separated geographically), than to its nearest neighbor, *mazama*, while in color it is very close to *pinetorum*, with which it also agrees in a Transition Zone range. Its relationship can best be shown by placing it as a subspecies of *monticola*.

Specimens examined.—Total number, 49, as follows:

Oregon: Bend, 12; Deschutes River (Farewell Bend), 2; Deschutes River (mouth of Davis Creek), 8; Fort Klamath, 1; Lapine, 12; Little Meadows, 1; Paulina Lake, 6; Pengra, 2; Yamsey Mountains, 9.

THOMOMYS MONTICOLA HELLERI Elliot.

Heller Pocket Gopher.

Thomomys helleri Elliot, Field Columb. Mus., zool. ser. III, 165, 1903.

Type.—Collected at Goldbeach, mouth of Rogue River, Oregon, by E. Heller, in 1901. No type designated. Type series in Field Mus. Nat. Hist.

Distribution.—Coast region of southwestern Oregon (fig. 5).

Characters.—About the size of *mazama*, but with darker richer coloration and slenderer skull.

Color.—*October pelage:* Upperparts dull chestnut or mars brown; sides and underparts becoming ochraceous; ear patches intense black; nose and face blackish, rarely a trace of white on lips; feet mottled or whitish; tip of tail usually white. *Young* of the year, duller colored.

Skull.—Similar to that of *mazama* but with narrower rostrum and nasals, smaller bullæ, and shorter pterygoids, with wider intervening fossa.

Measurements.—Average of 4 male topotypes: Total length, 203; tail vertebræ, 55; hind foot, 29. Average of 4 female typotypes: 195, 57, 27.2. *Skull* (of topotype ♂ ad.):[1] Basal length, 34; nasals, 14.3; zygomatic breadth, 22; mastoid breadth, 18.6; alveolar length of upper molar series, 7.5.

Remarks.—These gophers are abundant on the flats on both sides of the mouth of Rogue River but are not generally distributed on the coast nor back in the timbered interior. They form a partially isolated colony with their nearest relatives *mazama* on the open mountain ridges of the Coast Ranges and Cascades. Their group relationship is so clearly with *mazama* and *monticola* that it seems best to place them as a subspecies of *monticola*.

Specimens examined.—Total number, 19, as follows:

Oregon: Goldbeach, 11; Wedderburn (north side of river), 8.

Thomomys fuscus Group.

THOMOMYS FUSCUS FUSCUS Merriam.

Brown Pocket Gopher.

(Pl. VIII, figs. 13, 14; text fig. 4.)

Thomomys clusius fuscus Merriam, N. Am. Fauna No. 5, 69, July, 30, 1891.

Type.—Collected on mountains at head of Big Lost River, Idaho, at about 8,000 feet altitude, by B. H. Dutcher, September 23, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Southeastern British Columbia, greater part of northern and central Idaho and western Montana, northwestern Wyoming, and parts of eastern Washington and Oregon (fig. 5).

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[1] No. 166949, U. S. Nat. Mus.

Characters.—Size rather small; feet slender; ears small and pointed; color light brown; skull slender, with large bullæ; dentition light; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts light brownish or dull walnut-brown, not so dark as in *fossor* nor so bright as in *monticola* or *mazama;* ear patch black or blackish; nose plumbeous; underparts buffy; feet and tail soiled whitish or buffy; tail usually gray above at base. *Winter pelage:* Slightly duller than summer. *Young,* paler than adults.

Skull.—Light and slender with short rostrum and anteriorly converging lateral ridges; interparietal wide and oval; nasals short and truncate posteriorly, reaching nearly to tips of premaxillæ; bullæ full and rounded; pterygoids long and narrowly V-shaped; skulls of males and females very similar. *Dentition* light; upper incisors abruptly decurved and distinctly grooved.

Measurements.—Average of 3 topotypes (♂ ad): Total length, 203; tail vertebræ, 70; hind foot, 27. Average of 5 adult females: 205, 70, 27. *Skull* (of type, ♀ ad.): Basal length, 33; nasals, 12.4; zygomatic breadth, 20; mastoid breadth, 17; interorbital breadth, 6; alveolar length of upper molar series, 7.

Remarks.—This form is fairly typical in central Idaho, western Montana, and in the Blue Mountain region of Oregon. In northern Idaho, eastern Washington, and southern British Columbia it becomes noticeably darker, but retains more nearly the skull characters of *fuscus.* West of the Columbia River it varies greatly with almost every locality, but these local forms can be placed under *fuscus* better than with *quadratus* or *myops,* both of which they suggest.

Specimens examined.—Total number, 373, as follows:

British Columbia: Ashcroft, 1; Cascade, 6; Ducks, 5; Glacier, 1; Kamloops, 2; Midway, 6; Monashee Ridge (Gold Range, at 4,000 feet altitude, 5; at 3,620 feet, 4), 9; Myers Creek, 1; Nelson, 9; Okanogan, 10; Pend Oreille River, 11; Salmon River, 2; Shuswap, 20; Skagit Valley, 1; Trail, 1; Wards Ferry, 1.

Idaho: Ashton, 2; Big Lost River (head), 2; Blackfoot (west of river), 1; Blue Lake, 12; Cœur d'Alene, 4; Freedom (near mouth of South Fork Salmon River), 1; Hoodoo Valley, 1; Lemhi Indian Agency, 2; Lerdo, 1; Lost River Mountains, 5; Midvale, 7; Mission, 1; Mount Carlton, 3; New Meadows, 3; Salmon River Mountains, 11; Sawtooth Lake, 3; Seven Devils Mountains, 2; South Fork Ranch, 1; Teton Canyon, 1; Van Wyck, 1.

Montana: Beartooth Mountains, 3; Benton (west of), 1; Corvallis, 2; Flathead Lake, 4; Fort Ellis, 2; Little Bitterroot Creek, 1; Lo Lo, 1; Midvale, 2; Ross Fork, 1; St. Marys Lake, 3; Stevensville, 2; Summit (west of Blackfoot Station), 6; Thompson Falls, 8; Tobacco Plains, 10.

Oregon: Antelope, 2; Anthony, 14; Bingham Prairie, 1; Blue Mountains (10 miles north of Harney), 1; Elgin, 1; Huntington, 1; Wallowa Mountains, 8.

Washington: Blue Creek (13 miles east of Walla Walla), 3; Chelan, 2; Cheney, 1; Colfax, 1; Columbia County (25 miles southeast of Dayton and Humpeg Falls), 2; Colville, 6; Davenport, 1; Douglas, 2; Easton, 9; Fort Spokane, 1; Garfield, 1; Loon Lake, 2; Mabton, 3; Marcus, 5; Marshall, 11; Natches River, 1; North Yakima, 22; Orondo, 1; Pullman, 11; Rock Lake, 2; Spokane Bridge, 3; Spokane Falls, 15; Waterville, 1; Wenatchee, 8.

Wyoming: Black Mountains, 4; Moran, 4; Pahaska, 4; Pahaska Tepee. 12; Teton Mountains, 6; Teton Pass, 4; Yellowstone Lake, 1.

THOMOMYS FUSCUS SATURATUS BAILEY.

CŒUR D'ALENE POCKET GOPHER.

(Pl. VIII, fig. 16.)

Thomomys fuscus saturatus Bailey, Proc. Biol. Soc. Washington, XXVII, 117, July 10, 1914.

Type.—Collected at Silver (near Saltese) in the western corner of Missoula County, Montana, at 4,300 feet altitude, in the Cœur d'Alene Mountains, by Clark P. Streator, June 20, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Higher parts of the Cœur d'Alene Mountains in Idaho and Montana (fig. 5).

Characters.—Considerably larger than *fuscus*, with darker, richer coloration and less tendency to white markings below; skull long and high, with relatively narrower braincase and wider nasals.

Color.—*Summer pelage:* Upperparts dark rich hazel, becoming yellowish on sides, and this shading into a buffy wash on underparts; ear patches black; nose plumbeous; feet and tail buffy gray; rarely a trace of white on chin or throat. Only June and August specimens seen. The young are a shade paler than adults.

Skull.—Long and narrow with high, truncate occiput; lateral ridges prominent and nearly parallel; nasals widened anteriorly and emarginate posteriorly; premaxillæ very narrow posteriorly; bullæ wide and flattened; basioccipital relatively wide between bullæ.

Measurements.—Type (♂ ad.): Total length, 225; tail vertebræ, 77; hind foot, 30. Average of 3 adult males: 216, 72, 29. Average of 5 females: 211, 75, 28.7. *Skull* (of type): Basal length, 33.2; nasals, 13.7; zygomatic breadth, 21.4; mastoid breadth, 17; alveolar length of upper molar series, 7.

Remarks.—This seems to be a well-marked but rather local form of the *fuscus* group occupying the higher hemlock-covered part of the Cœur d'Alene Mountains. Specimens from Prospect Creek, lower down on the east slope, show intermediate characters approaching *fuscus* while others from Thompson Falls, at the east base of the mountains are almost typical of *fuscus*.

Specimens examined.—Total number, 26, as follows:

Idaho: Mullan, 3.

Montana: Prospect Creek, 6; Silver, 16; Thompson Pass, 1.

THOMOMYS FUSCUS LORINGI Bailey.

Alberta Pocket Gopher.

(Pl. VIII, fig. 9.)

Thomomys fuscus loringi Bailey, Proc. Biol. Soc. Washington, XXVII, 118, July 10, 1914.

Type.—Collected at South Edmonton, Alberta (exact locality not given), by J. Alden Loring, September 23, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from Edmonton and Moose Mountain, Alberta (fig. 5).

Characters.—Similar to *fuscus*, but slightly larger and duller colored, with relatively heavier dentition, and small, circular interparietal; ears small and pointed.

Color.—*Winter pelage* (September 23): Upperparts dull russet-brown, becoming rich buff on sides; nose slaty gray; small ear patch black; underparts rich buffy over plumbeous; chin and small spot on breast white; feet soiled whitish; tail pale buffy. *Summer pelage* (in two July 2 specimens from Moose Mountains): Similar but slightly brighter russet.

Skull.—Long and slender, with narrow braincase and small, nearly quadrate zygomatic arches, and almost circular interparietal; incisors less abruptly decurved than in *fuscus*; molars heavier; bullæ about the same; basioccipital somewhat triangular; nasals narrow and truncate at posterior tips.

Measurements.—Type (♂ ad.): Total length, 199; tail vertebræ, 47; hind foot, 26.5. *Skull* (of type): Basal length, 34; nasals, 12.8; zygomatic breadth, 20.5; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 8.

Remarks.—Although represented by only one specimen from the type locality, which is well out on the plains, this is evidently a form of the mountain species *fuscus* from farther south and west. Two skins in the Victoria Memorial Museum from Moose Mountain are apparently the same, while specimens from St. Marys Lake, Glacier Park, Mont., show a slight tendency toward the characters represented by this form, but are much nearer typical *fuscus*. Specimens from Shuswap, British Columbia, much farther west, show none of the characters of this form. There are no specimens of gophers available from the mountains of western Alberta, between Moose Mountain and the Montana line, but in this strip of country no collections have been made, and probably gophers occur along the eastern slope of the mountains from the United States boundary north to the Edmonton region.

Loring collected specimens of *talpoides* about Edmonton, but these large, dark-colored, large-footed gophers are quite distinct from the present little brown form. There were no notes to indicate whether the two species occupy the same or separate areas.

In the type specimen the upper molars are abnormally close together at the anterior base, but this is probably not characteristic of the species. Unfortunately there are no skulls for the Moose Mountain specimens, but the skins match the type in color. They are both breeding females collected July 2 by W. Spreadborough and are particularly interesting in showing fully developed sets of 12 mammæ each; inguinal 2–2, abdominal 2–2, pectoral 2–2. This is the formula for the *talpoides* and not for the *fuscus* group. The status of the form is at present very uncertain and will be until more collecting is done in the type region.

Specimens examined.—Total number, 3, as follows:

Alberta: South Edmonton, 1; Moose Mountain, 2 (skins only).

THOMOMYS FUSCUS MYOPS MERRIAM

LITTLE-HEADED POCKET GOPHER.

(Pl. VIII, fig. 15.)

Thomomys myops Merriam, Proc. Biol. Soc. Washington, XIV, 112, July 19, 1901.

Type.—Collected at Conconully, Okanogan County, Washington, by J. Alden Loring, September 11, 1897. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 5).

Characters.—Size smaller than *fuscus* but with very similar coloration and the same minute ears; skull small; tips of premaxillæ even with posterior tips of nasals.

Color.—*September pelage:* Upperparts light brownish or dull walnut-brown; ear patch blackish; nose plumbeous; underparts and base of tail buffy; feet and tip of tail whitish; chin usually white. *Young,* paler, more grayish.

Skull.—Small, but of about the form and proportions of that of *fuscus;* nasals and premaxillæ terminating posteriorly on an approximately even line; interparietal transversely elongated; bullæ small; anterior shaft of basioccipital relatively wide; pterygoids wide apart, with edges flattened at base.

Measurements.—Average of 2 topotypes (♂ ad.): Total length, 182; tail vertebræ, 57; hind foot, 25. Average of 5 females: 186, 59, 24.4. *Skull* (of type, ♀ ad.): Basal length, 31.8; nasals, 12.5; zygomatic breadth, 20; mastoid breadth, 17.5; alveolar length of upper molar series, 7.5.

Remarks.—Specimens from the type locality, Conconully, on Conconully Creek, a western affluent of the Okanogan River, are very uniform in characters and so peculiar that they were originally described with full specific rank. They evidently belong to the *fuscus* group, however, which shows great variation in that general region, and probably mark only a local valley form partly cut off from the general range of the species.

Specimens examined.—Seven, from type locality.

THOMOMYS HESPERUS MERRIAM.

WEST COAST POCKET GOPHER.

(Pl. VIII, fig. 10.)

Thomomys hesperus Merriam, Proc. Biol. Soc. Washington, XIV, 116, July 19, 1901.

Type.—Collected at Tillamook, Tillamook County, Oregon, by J. Ellis McLellan, November 9, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Coast region of northwestern Oregon (fig. 5).

Characters.—Size very small, with the small, pointed ears of the *fuscus* group; color dark rich auburn; skull small, short, and rounded.

Color.—Upperparts bright rich auburn, brighter than in *helleri* or *melanops*, darker and richer than in *mazama;* nose and cheeks dusky; large ear patch black; underparts lighter, more ochraceous; lining of cheek pouches white; feet and tip of tail whitish.

Skull.—Short; braincase rather wide; rostrum short and wide; posterior tip of nasals emarginate; bullæ very small, short, and rounded; basioccipital short and wide; pterygoids low and wide apart; molars very small but apparently of about the same proportions as those of *fuscus*.

Measurements.—Type (♀ ad.): Total length, 175; tail vertebræ, 54; hind foot, 24. Old male from Chintimini Mountains: 210, 60, 27. *Skull* (of type): Basal length, 27.3; nasals, 10.7; zygomatic breadth, 18; mastoid breadth, 15; interorbital breadth, 6; alveolar length of upper molar series, 6. Skull of old male from Chintimini Mountains: 30, 12.4, 20, 16.5, 6, 7.

Remarks.—This is evidently a little, dark form of the *fuscus* group, which seems to be isolated below the mouth of the Columbia River. In color it strongly resembles *melanops* of the Olympic Mountains and *helleri* from farther south, but the tiny ears and general skull characters seem to place it in the *fuscus* group. Until a good series of specimens of adult males is obtained its true position can not be fully determined. An old male from the top of Chintimini Mountains (near Corvallis) seems to be the same, but may not be wholly typical.

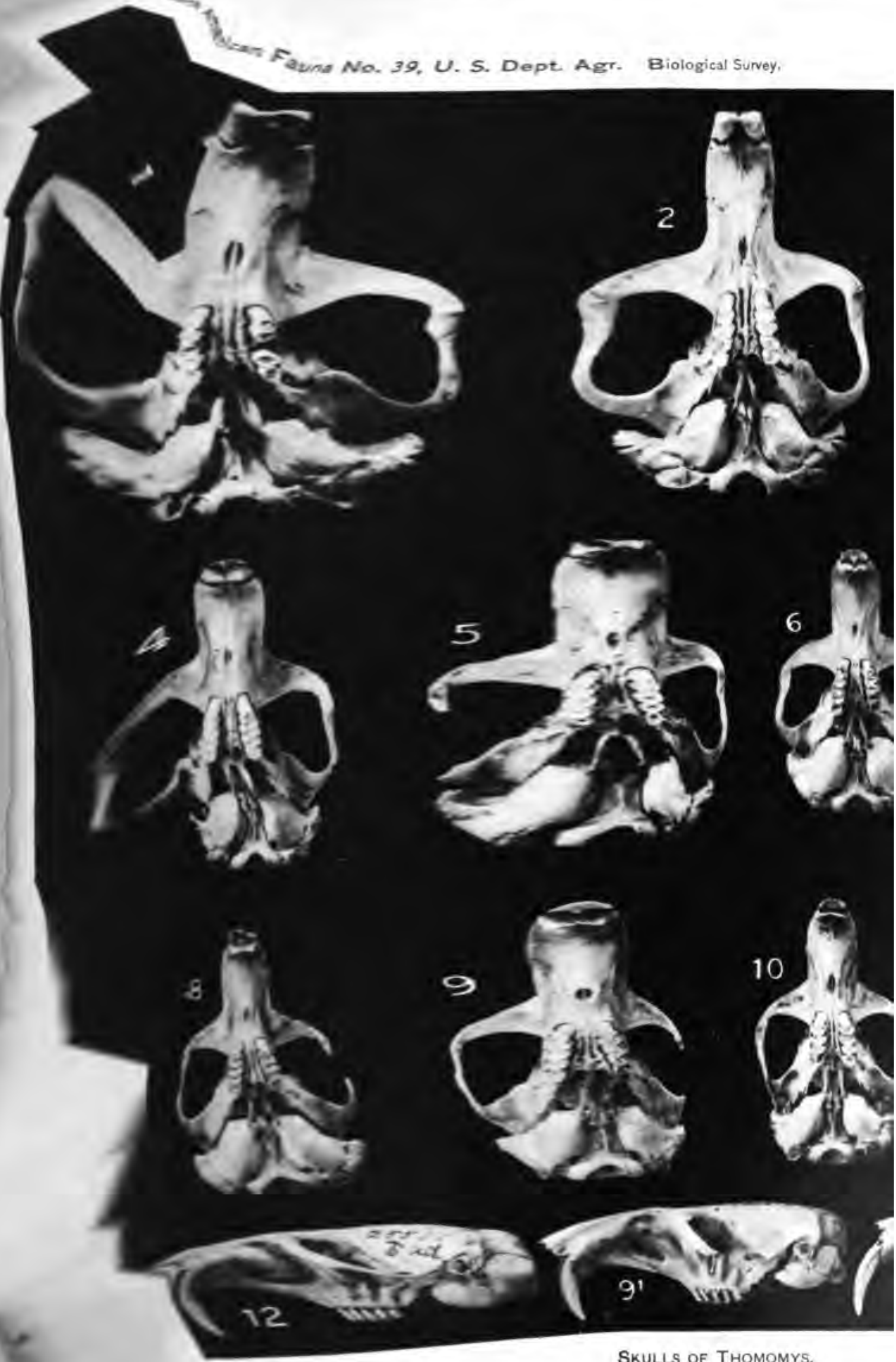
Specimens examined.—Total number, 6, as follows:

Oregon: Chintimini Mountains (at 4,000 feet altitude), 1 old male; Tillamook, 5 (no adult males).

PLATE II.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

FIG. 1. *Thomomys bulbivorus*, ♂, Beaverton, Oreg. (No. 57337.)
2. *Thomomys townsendi townsendi*, ♂, Nampa, Idaho. (No. 181196.)
3. *Thomomys bottæ bottæ*, ♂, Point Reyes, Cal. (No. 134989.)
4. *Thomomys perpallidus aureus*, ♂, topotype, Bluff, Utah. (No. 57166.)
5. *Thomomys talpoides rufescens*, ♂, near Ft. Clark, N. Dak. (No. 161381.)
6. *Thomomys talpoides clusius*, ♂, topotype, Bridger Pass, Wyo. (No. 25534.)
7. *Thomomys idahoensis*, ♂, type, Birch Creek, Idaho. (No. 30900.)
8. *Thomomys fossor*, ♂, Lake City, Colo. (No. 48190.)
9. *Thomomys monticola monticola*, ♂, topotype, Tallac, Cal. (No. 100660.) Dorsal and lateral view.
10. *Thomomys douglasi douglasi*, ♂, topotype, Vancouver, Wash. (No. 65928.)
11. *Thomomys bottæ leucodon*, ♂, Ashland, Oreg. (No. 203671.) Lateral view.
12. *Thomomys ocius*, ♂, type, Fort Bridger, Wyo. (No. 25586.)
13. *Thomomys umbrinus umbrinus*, ♂, Boca del Monte, Vera Cruz. (No. 64093.)



SKULLS OF THOMOMYS.

1. T. bulbivorus.
2. T. t. townsendi.
3. T. b. bottæ.
4. T. p. aureus.
5. T. t. rufescens.
6. T. t. clusius.
7. T. idahoensis.
8. T. fossor.
9 and 9¹. T. m. monticola.

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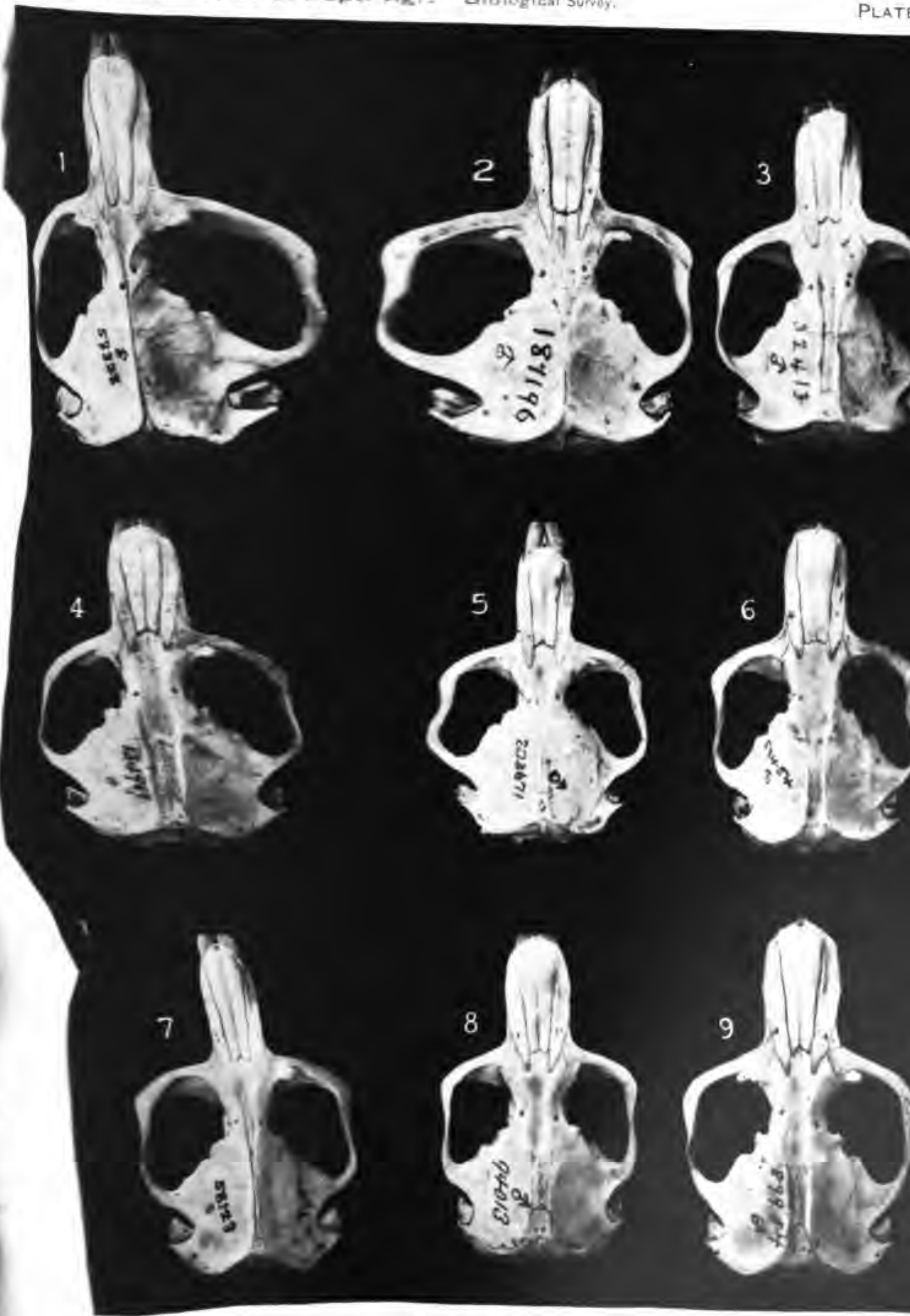
PLATE III.

[Natural size: all from U. S. Nat. Mus., Biological Survey collection.]

FIG. 1. *Thomomys bulbivorus*, ♂, Salem, Oreg. (No. 57328.)
2. *Thomomys townsendi townsendi*, ♂, type, Nampa, Idaho. (No. 181196.)
3. *Thomomys townsendi nevadensis*, ♂, type, Austin, Nev. (No. 32413.)
4. *Thomomys bottæ bottæ*, ♂, Point Reyes, Cal. (No. 134989.)
5. *Thomomys bottæ leucodon*, ♂, Ashland, Oreg. (No. 203671.)
6. *Thomomys bottæ laticeps*, ♂, topotype, Arcata, Cal. (No. 58454.)
7. *Thomomys bottæ angularis*, ♂, type, Los Banos, Cal. (No. 58123.)
8. *Thomomys bottæ pallescens*, ♂, topotype, Grapeland, Cal. (No. 94013.)
9. *Thomomys altivallis*, ♂, topotype, San Bernardino Mountains, Cal. (No. 89954.)



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SKULLS OF THOMOMYS.

1. T. bulbivorus.
2. T. t. townsendi.
3. T. t. nevadensis.

4. T. b. bottæ.
5. T. b. leucodon.
6. T. b. laticeps.

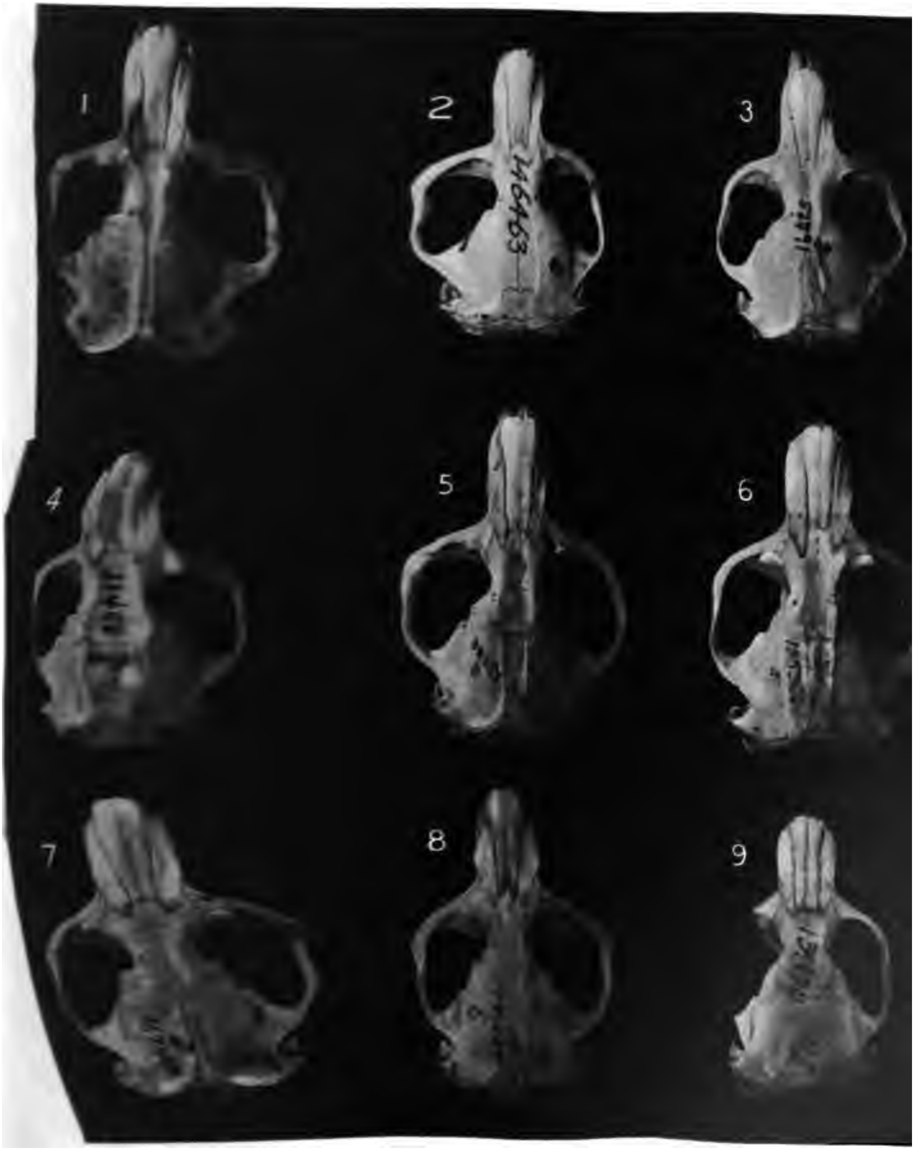
7. T. b. angularis.
8. T. b. pallescens.
9. T. altivallis.

PLATE IV.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

FIG. 1. *Thomomys bottæ pascalis*, ♂, type, Fresno, Cal. (No. 44702.)

2. *Thomomys bottæ minor*, ♂, type, Fort Bragg, Cal. (No. 146463.)
3. *Thomomys bottæ navus*, ♂, type, Red Bluff, Cal. (No. 57791.)
4. *Thomomys fulvus texensis*, ♂, type, Davis Mountains, Tex. (No. 31408.)
5. *Thomomys fulvus pervagus*, ♂, type, Espanola, N. Mex. (No. 58293.)
6. *Thomomys perpallidus apache*, ♂, type, La Jara Lake, N. Mex. (No. 135366.)
7. *Thomomys sinaloæ*, ♂, type, Altata, Sinaloa. (No. 96745.)
8. *Thomomys bottæ alticolus*, ♂, topotype, Victoria Mountains, Lower California. (No. 74208.)
9. *Thomomys bottæ russeolus*, ♂, type, San Angel, Lower California. (No. 139920.)



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SKULLS OF THOMOMYS.

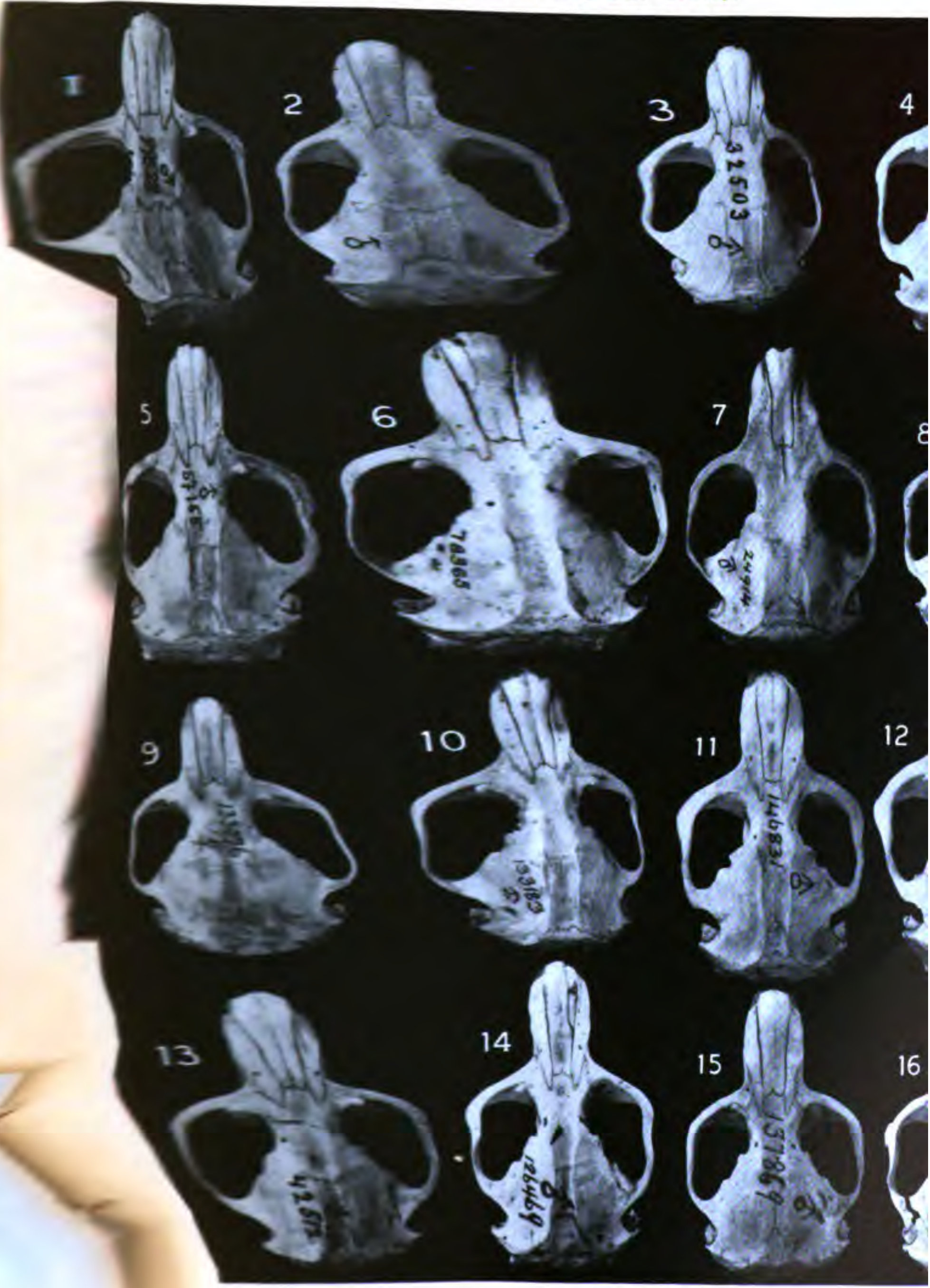
1. T. b. pascalis.
2. T. b. minor.
3. T. b. navus.
4. T. f. texensis.
5. T. f. pervagus.
6. T. p. apache.
7. T. sinaloæ.
8. T. b. alticolus.
9. T. b. russeolus.

Plate V.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection, except fig. 2.]

Fig. 1. *Thomomys perpallidus albatus*, ♂, topotype, Fort Yuma, Cal. (No. 99528.)

2. *Thomomys perpallidus perpallidus*, ♂, topotype, Palm Springs, Cal. (No. 4, collection of Dr. William Bebb.)
3. *Thomomys perpallidus perpes*, ♂, type, Lone Pine, Cal. (No. 32503.)
4. *Thomomys operarius*, ♂, type, Keeler, Cal. (No. 32466.)
5. *Thomomys perpallidus aureus*, ♂, topotype, Bluff, Utah. (No. 57155.)
6. *Thomomys perpallidus canus*, ♂, type, Deep Hole, Nev. (No. 78365.)
7. *Thomomys latirostris*, ♂, type, Painted Desert, Ariz. (No. 24914.)
8. *Thomomys cabezonæ*, ♂, type, Cabezon, Cal. (No. 53989.)
9. *Thomomys alpinus awahnee*, ♀, type, Yosemite Valley, Cal. (No. 133076.)
10. *Thomomys bottæ mewa*, ♂, type, Raymond, Cal. (No. 133183.)
11. *Thomomys bottæ anitæ*, ♂, topotype, Santa Anita, Lower California. (No. 146831.)
12. *Thomomys magdalenæ*, ♂, type, Magdalena Island, Lower California. (No. 146832.)
13. *Thomomys alpinus alpinus*, ♂, type, Mount Whitney, Cal. (No. 42512.)
14. *Thomomys jacinteus*, ♂, San Jacinto Mountains (Tahquitz Valley), Cal. (No. 126469.)
15. *Thomomys neglectus*, ♂, type, San Antonio Mountains, Cal. (No. 137869.)
16. *Thomomys bottæ nigricans*, ♂, topotype, Witch Creek, Cal. (No. 148685.)



SKULLS OF THOMOMYS.

1. T. p. albatus.
2. T. p. perpallidus.
3. T. p. perpes.
4. T. p. operarius.
5. T. p. aureus.

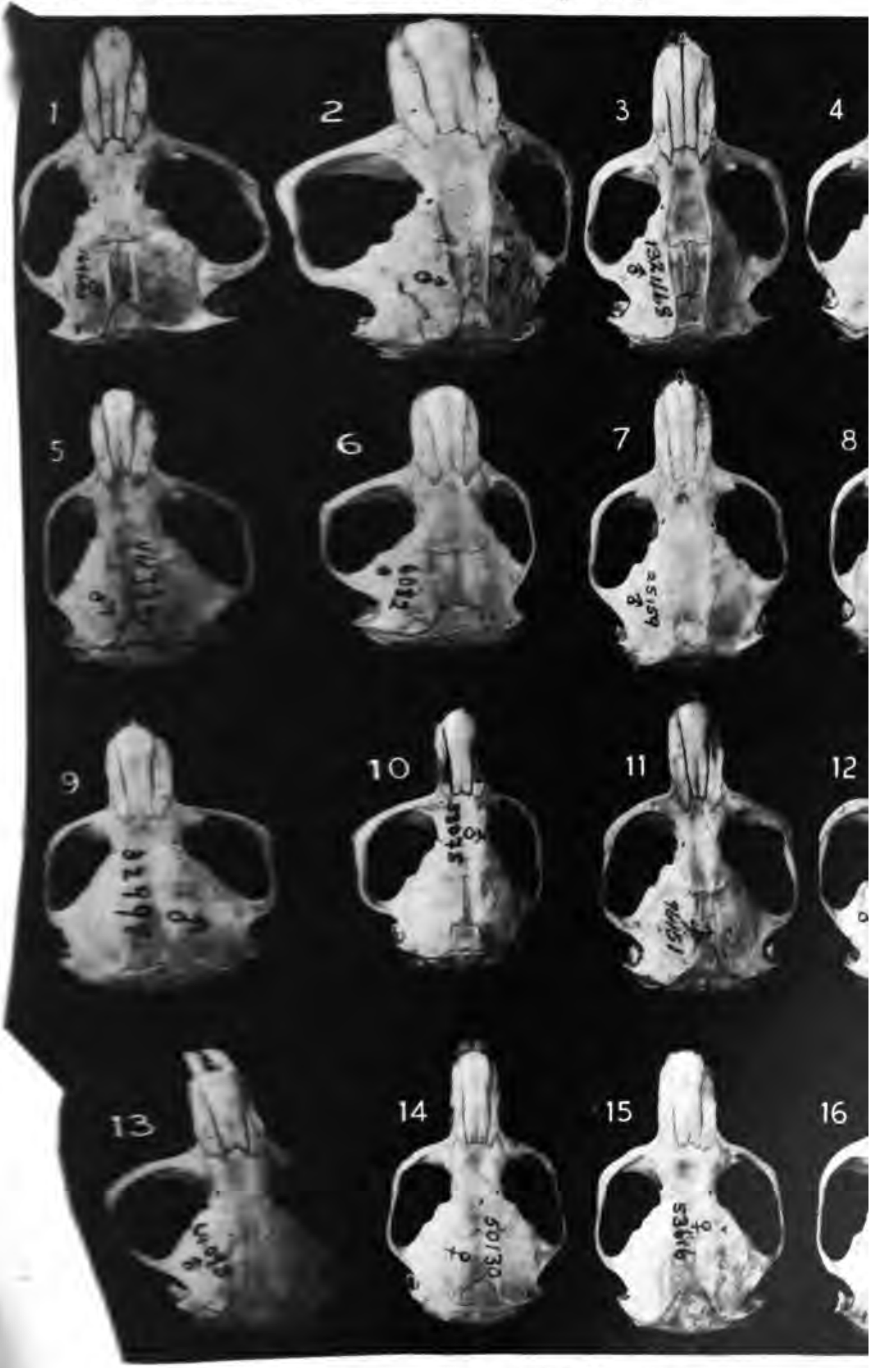
6. T. p. canus.
7. T. latirostris.
8. T. cabezonæ.
9. T. a. awahnee.
10. T. b. mewa.
11. T. b. anitæ.

12. T. ma
13. T. a. al
14. T. jaci
15. T. neg
16. T. b. n

Plate VI.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

Fig. 1. *Thomomys fulvus fulvus*, ♂, Flagstaff, Ariz. (No. 169603.)
2. *Thomomys cervinus*, ♂, topotype, Phoenix, Ariz. (No. 23707.)
3. *Thomomys fulvus toltecus*, ♂, typical, Colonia Diaz, Chihuahua. (No. 132468.)
4. *Thomomys mearnsi*, ♂, type, Animas Valley, N. Mex. (No. 157008.)
5. *Thomomys fulvus intermedius*, ♂, Fort Huachuca, Ariz. (No. 46334.)
6. *Thomomys fulvus desertorum*, ♂, type, Mud Spring, Ariz. (No. 6082.)
7. *Thomomys baileyi*, ♂, type, Sierra Blanca, Tex. (No. 25159.)
8. *Thomomys lachuguilla*, ♂, type, El Paso, Tex. (No. 110336.)
9. *Thomomys perditus*, ♂, type, Lampazos, Nuevo Leon. (No. 32998.)
10. *Thomomys goldmani*, ♂, type, Mapimi, Durango. (No. 58075.)
11. *Thomomys nelsoni*, ♂, type, Parral, Chihuahua. (No. 96451.)
12. *Thomomys sheldoni*, ♂, type, Santa Teresa, Tepic. (No. 90819.)
13. *Thomomys umbrinus umbrinus*, ♂, Boca Del Monte, Vera Cruz. (No. 64093.)
14. *Thomomys umbrinus peregrinus*, ♀, type, Salazar, Mexico. (No. 50130.)
15. *Thomomys umbrinus orizabæ*, ♀, type, Mount Orizaba, Puebla. (No. 53616.)
16. *Thomomys atrovarius*, ♂, typical, Mazatlan, Sinaloa. (No. 96750.)



SKULLS OF THOMOMYS.

1. T. f. fulvus.
2. T. cervinus.
3. T. f. toltecus.
4. T. mearnsi.
5. T. f. intermedius.
6. T. f. desertorum.
7. T. baileyi.
8. T. lachuguilla.
9. T. perditus.
10. T. goldmani.
11. T. nelsoni.
12. T. shel
13. T. u. u
14. T. u. p
15. T. u. o
16. T. atro

PLATE VII.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

FIG. 1. *Thomomys talpoides rufescens*, ♂, near Fort Clark, N. Dak. (No. 161381.)
2. *Thomomys talpoides bullatus*, ♂, type, Powderville, Mont. (No. 55159.)
3. *Thomomys talpoides nebulosus*, ♂, type, Sand Creek Canyon, Wyo. (No. 202495.)
4. *Thomomys talpoides agrestis*, ♀, type, Medano Ranch, Colo. (No. 150725.)
5. *Thomomys talpoides clusius*, ♂, topotype, Bridgers Pass, Wyo. (No. 25534.)
6. *Thomomys talpoides caryi*, ♀, type, Bighorn Mountains, Wyo. (No. 168946.)
7. *Thomomys talpoides pryori*, ♂, type, Pryor Mountains, Mont. (No. 66469.)
8. *Thomomys quadratus quadratus*, ♂, type, The Dalles, Oreg. (No. 31117.)
9. *Thomomys ocius*, ♂, type, Fort Bridger, Wyo. (No. 25586.)
10. *Thomomys idahoensis*, ♂, type, Birch Creek, Idaho. (No. 30900.)
11. *Thomomys pygmæus*, ♂, type, Montpelier Creek, Idaho. (No. 55271.)
12. *Thomomys columbianus*, ♂, type, Touchet, Wash. (No. 57134.)
13. *Thomomys fossor*, ♂, Lake City, Colo. (No. 48190.)
14. *Thomomys uinta*, ♂, type, Uinta Mountains, Utah. (No. 30051.)
15. *Thomomys bridgeri*, ♂, type, Fort Bridger, Wyo. (No. 25592.)
16. *Thomomys quadratus fisheri*, ♂, type, Sierra Valley, Cal. (No. 101238.)

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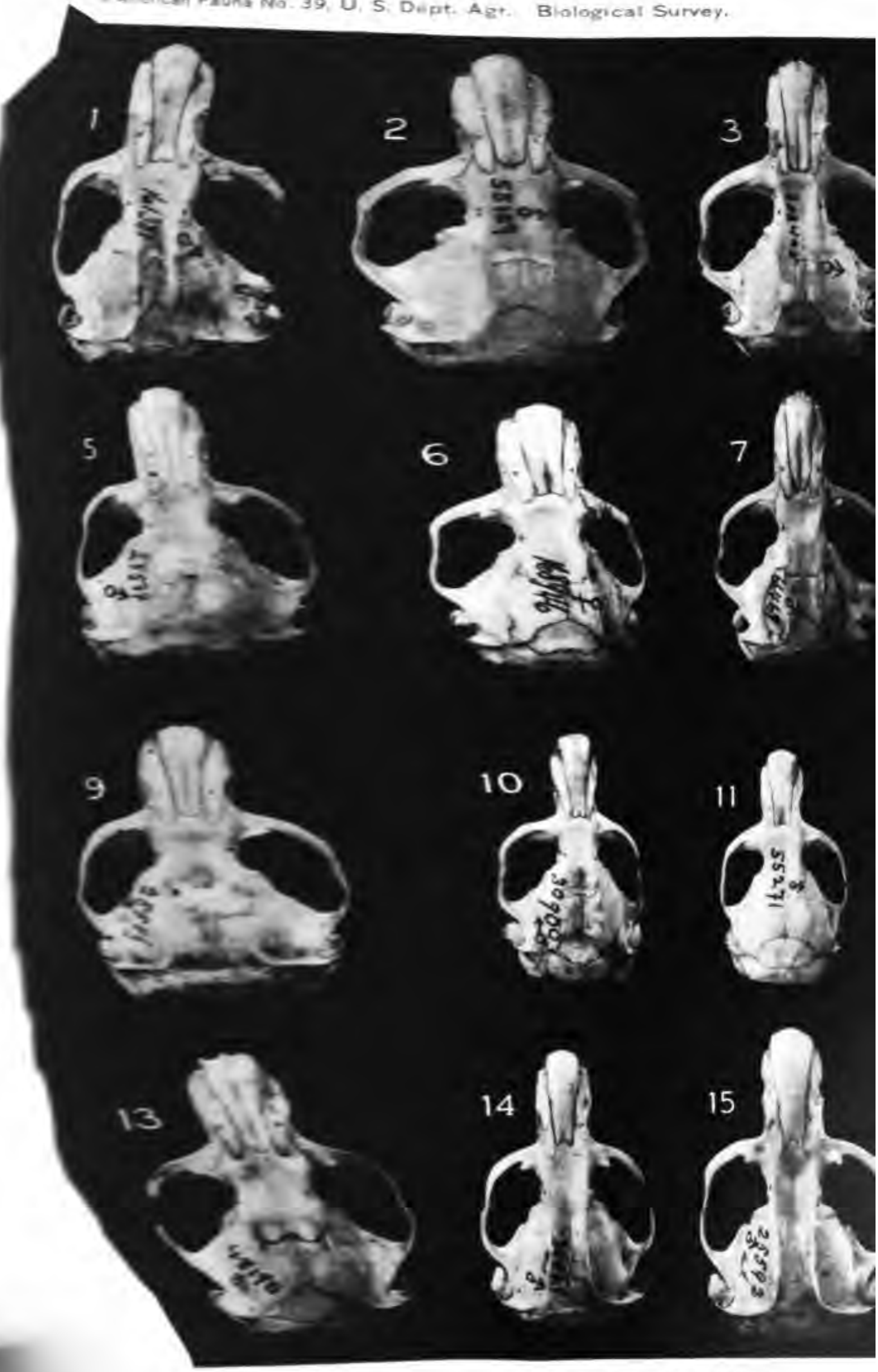


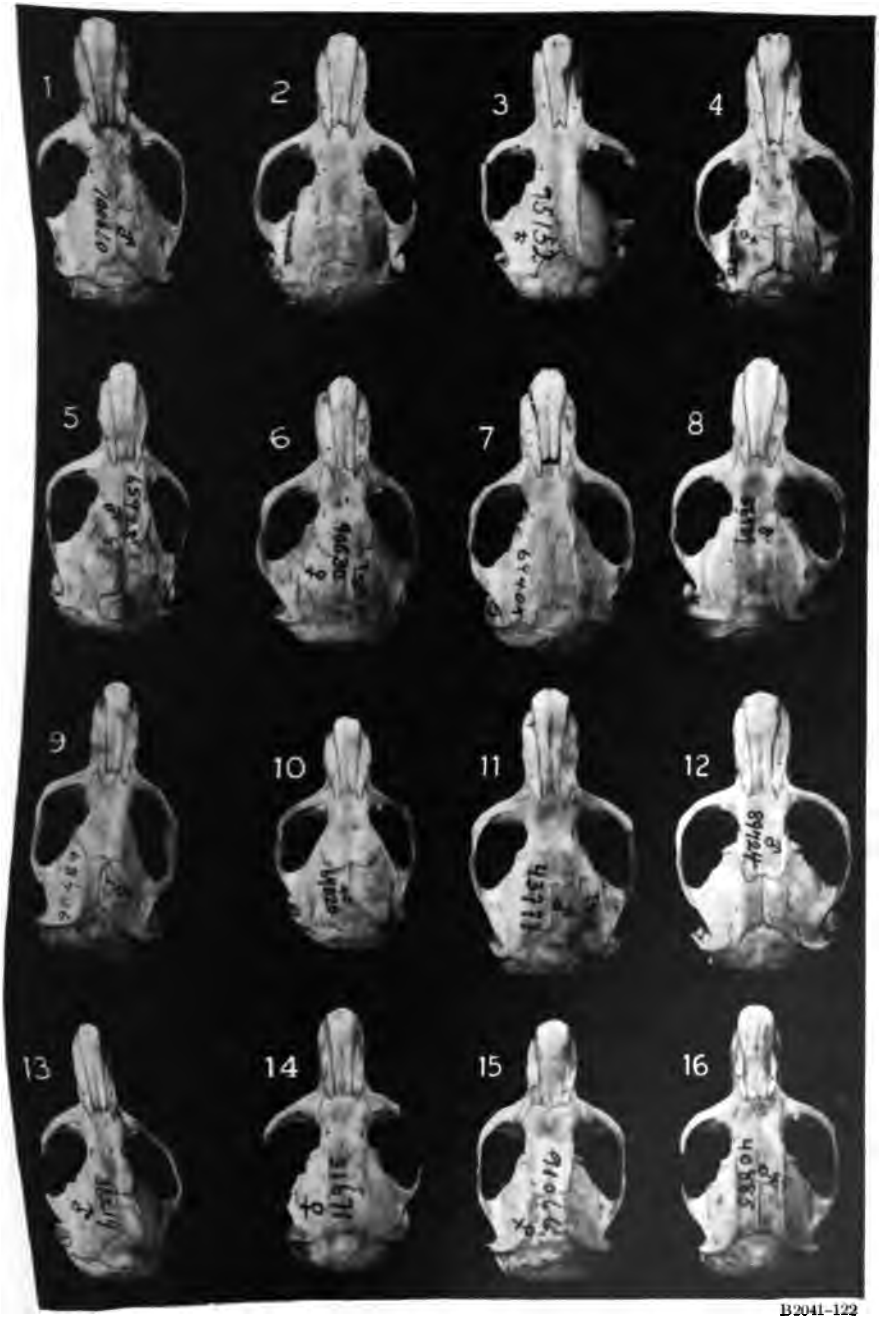
SKULLS OF THOMOMYS.

1. T. t. rufescens.
2. T. t. bullatus.
3. T. t. nebulosus.
4. T. t. agrestis.
5. T. t. clusius.
6. T. t. caryi.
7. T. t. pryori.
8. T. q. quadratus.
9. T. ocius.
10. T. idahoensis.
11. T. pygmæus.

Plate VIII.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

Fig. 1. *Thomomys monticola monticola*, ♂, topotype, Tallac, Cal. (No. 100660.)
2. *Thomomys monticola mazama*, ♂, type, Anna Creek, Oreg. (No. 80502.)
3. *Thomomys monticola pinetorum*, ♂, type, Sisson, Cal. (No. 95152.)
4. *Thomomys monticola nasicus*, ♂, type, Farewell Bend, Deschutes River, Oreg. (No. 79815.)
5. *Thomomys douglasi douglasi*, ♂, topotype, Vancouver, Wash. (No. 65928.)
6. *Thomomys douglasi melanops*, ♀, type, Olympic Mountains, Wash. (No. 90630.)
7. *Thomomys niger*, ♂, type, Seaton, Oreg. (No. 69407.)
8. *Thomomys douglasi oregonus*, ♂, type, Oregon City, Oreg. (No. 56939.)
9. *Thomomys fuscus loringi*, ♂, type, Edmonton, Alberta. (No. 68746.)
10. *Thomomys hesperus*, immature ♀, type, Tillamook, Oreg. (No. 69825.)
11. *Thomomys douglasi yelmensis*, ♂, type, Tenino, Wash. (No. 43777.)
12. *Thomomys limosus*, ♂, type, White Salmon, Wash. (No. 89724.)
13. *Thomomys fuscus fuscus*, ♂, Lemhi, Idaho. (No. 31219.)
14. *Thomomys fuscus fuscus*, ♀, type, head of Big Lost River, Idaho. (No. 31671.)
15. *Thomomys fuscus myops*, ♀, type, Conconully, Wash. (No. 91066.)
16. *Thomomys fuscus saturatus*, ♂, typo, Silver, Mont. (No. 40885.)



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SKULLS OF THOMOMYS.

1. T. m. monticola.
2. T. m. mazama.
3. T. m. pinetorum.
4. T. m. nasicus.
5. T. d. douglasi.
6. T. d. melanops.
7. T. niger.
8. T. d. oregonus.
9. T. f. loringi.
10. T. hesperus.
11. T. d. yelmensis.
12. T. limosus.
13. T. f. fuscus, ♂.
14. T. f. fuscus, ♀.
15. T. f. myops.
16. T. f. saturatus.

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BY

N. HOLLISTER
ASSISTANT CURATOR OF MAMMALS, UNITED STATES
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BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., November 16, 1915.

Sir: I have the honor to transmit herewith for publication as North American Fauna No. 40, a systematic account of the prairie-dogs of North America, by Mr. N. Hollister, Assistant Curator of Mammals, of the United States National Museum. This review of the group is based largely upon material in the collection of the Biological Survey. Prairie-dogs are distributed over a large part of the Great Plains and Rocky Mountain regions. Their colonies often number thousands of individuals, and their destruction of grasses and other forage plants makes them of considerable economic importance. Drastic measures are frequently necessary to prevent their destroying crops of grain and hay. The Biological Survey is engaged in exterminating these rodents in national forests and on the public domain. The definite information in this report in regard to the several species and their distribution, as indicated by maps, will materially aid in efforts, National or State, to control or exterminate them.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. David F. Houston,
Secretary of Agriculture.

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No. 40. NORTH AMERICAN FAUNA. June, 1916.

A SYSTEMATIC ACCOUNT OF THE PRAIRIE-DOGS.

By N. Hollister.

INTRODUCTION

The prairie-dog is a true ground squirrel, or spermophile, and its common designation "dog" is most unfortunate from the standpoint of exact science. The name is now so generally used, however, that any attempt to substitute one more appropriate would be futile. The animals may be conveniently divided into two general classes—the black-tailed prairie-dogs (subgenus *Cynomys*, three forms of two species) and the white-tailed prairie-dogs (subgenus *Leucocrossuromys*, four forms of three species).

DISTRIBUTION, HABITS, AND ECONOMIC RELATIONS.

Early explorers of the Western States were much impressed by the peculiar habits of the prairie-dog, one of the most abundant and conspicuous mammals over much of what was then "Louisiana" and the region of the upper Missouri River. Their journals and narratives contain numerous references to this spermophile under such names as prairie-dog, petit chien, wishtonwish, barking squirrel, and prairie squirrel, together with long accounts of the "dog-towns" and the social habits and notes of alarm of the animals. As usual in the case of a new and interesting animal, these accounts are partly true and partly erroneous, having been drawn from actual observation supplemented by stories of travelers, settlers, and Indians.

Prairie-dogs are distributed over a large part of the Great Plains and Rocky Mountain regions of the United States and southward into northern Mexico. This actual area is relatively small, however; the animals are found in no other region. Though the several forms are constantly extending their ranges into new valleys and pushing out into new pastures on the plains, the animal has penetrated into only a small area of the Great Basin, and seems sharply restricted by its specialized nature from occupying any great part of the humid eastern plains, the northern prairies of Canada, the Tropics, or the immense stretches beyond the Rockies.

The habits of the black-tailed species and, to a slightly less degree, those of the more mountain-loving white-tailed forms, are decidedly social. The great size of the "dog-towns" on the plains has indeed been one of the principal subjects of comment by early travelers. The villages sometimes extend for many miles and the number of individuals inhabiting a big town is enormous. While in certain localities the white-tailed species are almost as gregarious as the black-tailed forms, in others their dens are much more scattered and the animals live in solitary families. These differences in habit are due mainly to variations in local habitat. In certain parts of the mountainous ranges of *Cynomys gunnisoni* and of *C. leucurus*, the country is broken and otherwise unsuited to sustain large numbers of the animals, and the creatures necessarily live much as do certain rock squirrels of the genus *Citellus*, in isolated pairs or widely separated families.

The prairie-dog is not strictly a hibernating animal except at high altitudes or in the more northern regions where the great depth of snow and the extreme severity of winter make hibernation a virtual necessity. In the more southerly parts of the Great Plains there is actually no period of hibernation. In the central Plains States hibernation is partial and irregular, and even in the extreme north the animals are not infrequently seen out on fine winter days, though they hibernate for long periods during severe weather. In the higher mountainous habitat of the white-tailed forms the villages are often covered for many weeks with a great depth of snow, and activity on the part of the prairie-dogs is, therefore, out of the question. In such regions the animals are rarely seen after November or they may retire even by middle October. In the higher parts of the New Mexican range prairie-dogs cease to appear above ground by approximately the first of December, although, if conditions are favorable, they are out on fine days throughout the winter. In the Green River Basin, Wyoming, Vernon Bailey saw *Cynomys leucurus* eating sage-brush tips on snow a foot deep in zero (Fahrenheit) weather, and also after a night when the temperature had fallen to 22° below zero.

The burrows vary greatly according to local necessities. In some regions the mounds heaped up around entrances to dens are enormous, while in others they are smaller or almost wanting. Much rainfall necessitates high mounds, constant care, and incessant work by the industrious animals until the safety of the home is insured. The mounds in such cases are often especially well made and the earth is very hard packed. Each double armful of wet dirt which is pushed into position by the animal is rammed and packed into a firm condition by repeated drives with the nose; the body, in curved position, with shoulders bent, acts as a powerful machine to drive the hammerlike muzzle into the earth.

While at times virtually omnivorous, the prairie-dog finds its principal food in grasses and other green plants. Roots and stems are eaten as well as the tender leaves. In times of scant vegetation, or during a drought, the villages are almost destitute of plant life, so closely is every living bit cropped.

Prairie-dogs are unquestionably responsible for great annual damage to crops and pasturage. In certain areas the destruction amounts to virtually the entire forage. Crops of grain and cultivated hay are often entirely ruined unless drastic preventive measures are taken. In other out-of-the-way places the animals do not interfere in the least with the operations of man.

In captivity prairie-dogs eat almost any food, and are especially fond of cakes and fruit; watermelon also is relished.

NATURAL ENEMIES.

Among the principal natural enemies of the prairie-dog are the badger, coyote, black-footed ferret, eagle, rough-legged hawk, and raven. Prairie-dog meat furnishes much of the food of individuals of these species that live in close proximity to the villages. Many absurd stories of the joint occupation of dens by prairie-dogs, rattlesnakes, and burrowing owls have been written, but careful observers have found that whatever the relation between these denizens of the plain may be—and the creatures are often found together in the villages—it is anything but advantageous to the prairie-dog, and large numbers of its young are destroyed by the unwelcome visitors.

NOMENCLATURE.

Several systematic mammalogists early bestowed technical names on the prairie-dog, in some cases basing both names and descriptions wholly upon published accounts in explorers' narratives. The resulting confusion in both zoology and nomenclature was considerable. Systematists supposed the newly discovered prairie-dog to be a species of marmot, and the first technical name properly proposed for it, *Arctomys ludovicianus*, the Louisiana marmot, was given by George Ord in the second American edition of Guthrie's Geography, 1815. Ord's description was drawn from a stuffed specimen of the prairie-dog in Peale's Museum, and his account of the habits of the animal was taken chiefly from the history of Lewis and Clark's expedition, with supplemental observations from the narratives of Pike and Brackenridge. The specimen examined by Ord in Peale's Museum was certainly the skin collected by Lewis and Clark, and later, 1823, more fully described by Say.[1] This was doubtless the first specimen of the prairie-dog to reach any museum, and Lewis and Clark are probably entitled to the credit for the actual discovery of the species.

Rafinesque, in 1817, proposed the new genus *Cynomys* for the "barking squirrel" of Lewis and Clark, calling the species *Cynomys socialis*. At the same time he provisionally named the "petit chien" of these authors *Cynomys grisea*, not knowing that it too was a "barking squirrel." Warden, in his Historical Account of the United States, 1819, named the species *Monax missouriensis*, basing his description on information obtained in the narratives of late explorers, particularly Maj. Pike; and Harlan, 1825, based still another name, *Arctomys latrans*, on the barking squirrel of Lewis and Clark. These names have now been fixed in the synonymy of one species, but there was considerable confusion regarding the nominal species and their nomenclature up to the time of publication of Baird's Mammals of North America, 1857. In this work two species of *Cynomys* were recognized, one black-tailed and one white-tailed. Baird, who in 1855 had first described his *Spermophilus gunnisoni*, a species of the white-tailed group of prairie-dogs, from Colorado, still, in 1857, entertained considerable doubt as to whether his new species was distinct from a still more recently discovered white-tailed prairie-dog from Wyoming. To this latter form he thought the older name *Arctomys columbianus* of Ord, based on the "burrowing squirrel" of Lewis and Clark, might be applied, should further investigation establish its validity.

The next authoritative work on the group was Allen's Monograph of the Sciuridæ, 1877. In this work, as in his previous list of American Sciuridæ,[2] Dr. Allen recognized two species of prairie-dogs, the *ludovicianus* of Ord and a white-tailed species to which he applied the name *Cynomys columbianus* (Ord), treating *gunnisoni* of Baird as a synonym. As later pointed out by Dr. Merriam,[3] the name *columbianus* really belongs to a spermophile of the genus *Citellus*, and Baird's name *gunnisoni* is the earliest valid name for any member of the group of white-tailed prairie-dogs. Dr. Merriam had been able the previous year to substantiate Baird's suspicions of many years before regarding the existence of two distinct species of white-tailed prairie-dogs, and had named the Wyoming form *Cynomys leucurus*. The same year Dr. Mearns described a southwestern form of the *ludovicianus* type as *Cynomys arizonensis*, and in 1892 Merriam added *C. mexicanus* to the list of known species of the genus. The Sevier River valley white-tailed prairie-dog remained unknown, so far as systematists were concerned, until it was described and named by Dr. J. A. Allen in 1905.

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[1] Long's Exped. Rocky Mts., I, pp. 451–452, 1823.

[2] Proc. Boston Soc. Nat. Hist., XVI, p. 294, 1874.

[3] North Amer. Fauna No. 5, pp. 39–42, 1891.

In the present paper two subgenera of *Cynomys* are recognized. These are equivalent to the black-tailed and the white-tailed groups. One new subspecies is described and one currently recognized name is placed in synonymy, leaving the number of recognized forms at seven, the same as in the last (1912) general list of North American mammals.[1]

PELAGES AND MOLTS.

In all prairie-dogs, except *Cynomys mexicanus*, there are two well-marked annual molts over the entire animal, except on the tail, where there is only a single renewal each year. The two coats are the harsh, thin, summer pelage and the soft, heavily underfurred winter pelage. In southern States, where the spring molt takes place much earlier than in the North, the two renewals are conspicuous. Farther north and at greater altitudes, where the season is shorter, the summer coat is so little worn and the fall renewal so subtle that the autumnal change is difficult to detect.

In general, the spring molt begins on the pectoral region and axillæ, and the entire underparts from front to back are completely renewed before any real molt is visible above. On the upperparts, the head and shoulders, with occasional irregular areas on the back, renew first, and the renewal progresses posteriorly. Considerable wear is apparent over the anterior half of the back before the tail is in fresh coat. It is quite common to find museum specimens in full summer coat except for the tail, which retains the old pelage of the previous winter. In late summer or early autumn, at about the time when the tail is at last in full fresh pelage, the winter coat begins to appear on the extreme posterior parts of the body. The renewal of the underfur progresses anteriorly in a regular definite area, and the fresh, soft winter coat gradually covers the whole body. The autumnal renewal thus exactly reverses the order of progression in spring. The whole process is much as if there was a continuous summer change of hair which started at the nose in spring, worked backward to the tail, reversed, and in fall traveled forward to the nose again. The tail, midway in the route of this process, receives only one coat annually.

There is, naturally, a considerable variation in the season of renewal according to latitude or altitude. Breeding females are always slow to acquire the fresh coat, renewal being greatly retarded by lack of excess vitality. Young animals of the first year do not molt or renew at the same dates as do adult males and nonbreeding females which have lived over one winter. The molt of *Cynomys mexicanus* appears to be much more complex than in the more northern forms and is almost continuous. Some individuals of this species show parts of three distinct pelages.

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[1] Miller, G. S., jr., Bull. 79, U. S. Nat. Mus., pp. 294-295, 1912.

MATERIAL AND ACKNOWLEDGMENTS.

This revision of the prairie-dogs is based upon a study of 876 specimens, almost all of which are well-prepared skins and skulls.[1] A few skeletons and odd skulls also have been examined. The liberal policy of American museums has made it possible to assemble practically all the study material of the group preserved in American collections, including the types and type series. Thanks for these courtesies are especially due Dr. J. A. Allen, American Museum of Natural History; Mr. Samuel Henshaw and Mr. Outram Bangs, Museum of Comparative Zoology; Mr. Edward R. Warren, Colorado Springs, Colo.; and Mr. Charles B. Cory and Mr. W. H. Osgood, Field Museum of Natural History. Mr. Warren's private collection of Colorado specimens of *Cynomys leucurus* and *C. gunnisoni* has been of especial value and help. In the lists of specimens examined the source is indicated of all material from localities not represented in the United States National Museum collections.

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Genus CYNOMYS Rafinesque.

1817. *Cynomys* Rafinesque, Amer. Monthly Mag., II, p. 45.
1819. *Monax* Warden, Stat., Pol., and Hist. Acc. U. S., I, p. 226. Type, *Monax missouriensis* Warden (= *Cynomys ludovicianus*).
1827. *Cynomis* Lesson, Manuel de Mamm., p. 244 (pro *Cynomys* Rafinesque).
1894. *Cynomomus* Osborn, Science, XXIII, p. 103 (pro *Cynomys* Rafinesque).
1899. *Mamcynomiscus* Herrera, Sin. Vulg. Cient. Vert. Mexicanus, p. 22 (pro *Cynomys* Rafinesque).

Type species.—*Cynomys socialis* Rafinesque (= *Arctomys ludoviciana* Ord).

Diagnosis.—Like *Citellus*, but with cheek teeth relatively much larger; maxillary tooth rows strongly convergent posteriorly; molariform teeth with protocone much more hypsodont; and crown of last upper molar with well-developed mesostyle and accompanying additional transverse ridge.

General characters.—Size as in larger species of *Citellus* or greater; form stout; tail short, rarely more than one-fourth the total length; ears short, not extending beyond fur of winter pelage; cheek pouches moderate. Wrist and heel heavily furred; a tuft of hair in center of

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[1] The material examined has been assembled from collections as follows:

U. S. National Museum, Biological Survey collection	465
U. S. National Museum proper	221
American Museum of Natural History, New York, N. Y	81
Museum of Comparative Zoology, Cambridge, Mass	47
Collection of E. R. Warren, Colorado Springs, Colo	44
Field Museum of Natural History, Chicago, Ill	18
Total number of specimens	876

palm of foot usually extending forward to phalangeal tubercles; manus with five distinct claws, the claw of pollex well developed, subequal to claw of outer (fifth) toe. Mammæ 8 to 12. Skull rather broad and heavily built; sinciput high and rounded; squamosal arm of zygoma widely spreading; occipital crest well developed; sagittal crest moderate anteriorly, but well developed posteriorly in old adults; antorbital foramen subtriangular, with strongly developed tubercular process. Molar series strongly convergent posteriorly; teeth very large and greatly expanded laterally; first premolar large, sometimes nearly equal to second; crown pattern of molars essentially as in true *Citellus*, but teeth with higher crowns and deeper grooves; molars and premolars with protocone much more hypsodont; m^3 with additional transverse ridge extending (from mesostyle) across outer half of center of crown; upper incisors sometimes with very indistinct groove along inner face.

Color pattern.—Simple; body unmarked, not sharply bicolor. Upperparts reddish brown, buffy, or grayish, finely lined with darker or lighter hair-tips; underparts paler, clear buff or pale cinnamon. More or less well-marked dark areas above and below eye; tail conspicuously tipped with black or white.

Geographic distribution.—Rocky Mountain and Great Plains regions of the United States and northern Mexico. From the Milk River near the Canadian boundary in northern Montana south to northern San Luis Potosi, Mexico; east to the Missouri River in North Dakota and to about the ninety-seventh meridian in Nebraska and Oklahoma; west to the Rocky Mountains in Montana, to the valleys of central Utah, and to the border of the Grand Canyon on the Hualpai Indian Reservation, Arizona (figs. 1 and 2).

Remarks.—The prairie-dog is a true ground squirrel, or spermophile; there is no real evidence of the frequently suggested close relationship between *Cynomys* and *Marmota*.

In an article by Prof. K. A. Satunin in the Mitteilungen des Kaukasischen Museums, volume IV, pages 175 to 193, 1909, the conclusion is reached that *Colobotis* Brandt, currently recognized as a subgenus of *Citellus*, is a synonym of *Cynomys*. Through the kindness of Mr. Oldfield Thomas, I have been able to examine, from the collection of the British Museum, skulls of the type species of *Colobotis*—*Citellus fulvus* (Lichtenstein). It is at once apparent that *Cynomys* is even less closely related to *Colobotis* than to *Citellus* proper, and that it is unquestionably an error to use the generic name *Cynomys* for any of the Old World spermophiles. *Colobotis* is exceedingly like true *Citellus* and differs generically from *Cynomys* in the same characteristics, especially in the less complicated last upper molar, lack of the striking internal hypsodontism of the molariform teeth, and in the nearly parallel-sided palate.

List of Species and Subspecies with Type Localities.

Subgenus CYNOMYS.

Cynomys ludovicianus ludovicianus (Ord)	Upper Missouri River.
ludovicianus arizonensis Mearns	Point of Mountain, Arizona.
mexicanus Merriam	La Ventura, Coahuila, Mexico.

Subgenus LEUCOCROSSUROMYS.

Cynomys leucurus Merriam	Fort Bridger, Wyoming.
parvidens Allen	Buckskin Valley, Utah.
gunnisoni gunnisoni (Baird)	Cochetopa Pass, Colorado.
gunnisoni zuniensis nobis	Wingate, New Mexico.

Key to Species and Subspecies.

- *a.*[1] Tail tipped with black; jugal bone heavy, thickened, the outer face at angle of ascending branch presenting a broad triangular surface (*Cynomys*).
  - *b.*[1] Black on tail covering most of distal half; tail longer; audital bullæ large and greatly inflated; posterior border of inflected angle of mandible nearly at right angle to axis of jaw .... **C. mexicanus** (p. 21).
  - *b.*[2] Black on tail confined to distal third; tail shorter; audital bullæ smaller and less inflated; posterior border of inflected angle of mandible at angle of about 45° to axis of jaw.
    - *c.*[1] Coloration above in fresh summer pelage dark pinkish cinnamon; audital bullæ smaller; anterior face of maxillary root of zygoma deeply emarginate, **C. l. ludovicianus** (p. 14).
    - *c.*[2] Coloration above in fresh summer pelage more vinaceous-cinnamon; audital bullæ larger; superior surface of maxillary root of zygoma very broad, not deeply emarginate anteriorly .... **C. l. arizonensis** (p. 19).
- *a.*[2] Tail tipped and bordered with white; jugal bone weak, thin, and flat, the outer surface at angle of ascending branch only very slightly thickened, the margin rounded, not distinctly triangular (*Leucocrossuromys*).
  - *b.*[1] Terminal half of tail white, without dark center.
    - *c.*[1] Size larger; coloration in summer buffy or grayish (not reddish or rich cinnamon); skull with less interorbital breadth .... **C. leucurus** (p. 24).
    - *c.*[2] Size smaller; coloration in summer reddish or rich cinnamon (not buffy or grayish); skull with greater interorbital breadth...... **C. parvidens** (p. 27).
  - *b.*[2] Terminal half of tail with gray center, bordered and tipped with white.
    - *c.*[1] Size smaller, with smaller hind foot; coloration more buffy and blackish, less pinkish cinnamon and ochraceous .... **C. g. gunnisoni** (p. 29).
    - *c.*[2] Size larger, with larger hind foot; coloration more pinkish cinnamon and ochraceous, less buffy and blackish .... **C. g. zuniensis** (p. 32).

Subgenus CYNOMYS Rafinesque.

Characters.—Size large; tail comparatively long, averaging more than one-fifth the total length, and tipped with black; mammæ 8. *Skull:* Angular and massive; general shape of occipital region, viewed from behind, oval; jugal bone heavy, thickened, the outer surface at angle of ascending branch very broad, triangular, with inferior vertex produced far downward; maxillary root of zygoma correspondingly strengthened, the shelf and suprajugal arm much thickened. Teeth larger, more expanded laterally, than in species of the white-tailed group.

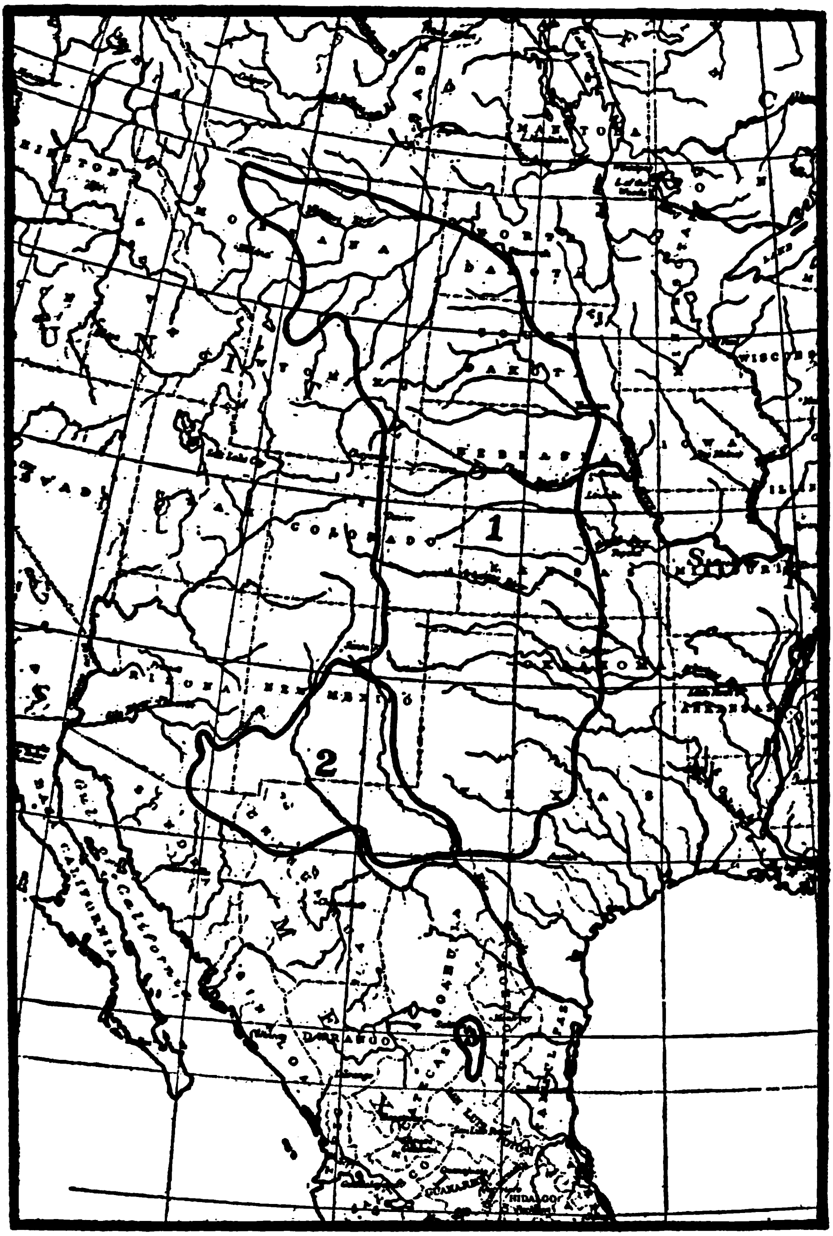

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Fig. 1.—Distribution of subgenus *Cynomys*: 1, *Cynomys ludovicianus ludovicianus*; 2, *C. l. arizonensis* 3, *C. mexicanus*.

CYNOMYS LUDOVICIANUS (ORD).

[Synonymy under subspecies.]

Characters.—Differs from *Cynomys mexicanus* in more reddish coloration and shorter tail; black area on terminal portion of tail much more restricted; skull with smaller audital bullæ and less developed triangular plate of jugal; teeth larger.

Subspecies.—Two subspecies of *Cynomys ludovicianus* are here recognized, the typical form, occupying a large part of the Great Plains region from Montana to Texas; and *C. l. arizonensis*, the more arid southwest, in New Mexico, Arizona, and adjacent portions of Mexico and southwestern Texas.

CYNOMYS LUDOVICIANUS LUDOVICIANUS (ORD).

BLACK-TAILED PRAIRIE-DOG.

(Pl. I, figs. 1, 4; Pl. II, figs. 1, 4; Pl. V, fig. 1; Pl. VI; Pl. VII, figs. 1, 7, 8.)

1815. *Arctomys ludoviciana* Ord, Guthrie's Geogr., 2d Amer. ed., II, pp. 292, 302.

1817. *Cynomys socialis* Rafinesque, Amer. Monthly Mag., II, p. 45, November. (Plains of the Missouri.)

1817. *Cynomys ? grisea* Rafinesque, Amer. Monthly Mag., II, p. 45, November. ("On the Missouri.")

1819. *Monax missouriensis* Warden, Stat., Pol., and Hist. Acc. U. S., I, p. 226. ("The Missouri country." Based largely on the account of "Major Pike, in his expedition through Louisiana.")

1822. *Arctomys missouriensis* Desmarest, Mammalogie, pt. 2, p. 329.

1825. *Arctomys ludoviciani* Harlan, Fauna Amer., p. 305.

1825. *Arctomys latrans* Harlan, Fauna Amer., p. 306. (Plains of the Missouri.)

1827. *Spermophilus ludovicianus* Lesson, Manuel de Mamm., p. 244.

1827. *Cynomis socialis* Lesson, Manuel de Mamm., p. 244 (syn.).

1827. *Spermophilus griseus* Lesson, Manuel de Mamm., p. 245.

1827. *Cynomis griseus* Lesson, Manuel de Mamm., p. 245 (syn.).

1827. *Cynomys griseus* Lesson, Manuel de Mamm., p. 260.

1829. *Arctomys ludovicianus* Cuvier, Règne Animal, I, p. 197.

1829. *A[rctomys] missuriensis* Fischer, Syn. Mamm., p. 345.

1829. *A[rctomys] griseus* Fischer, Syn. Mamm., p. 345.

1829. *Arctomys (Spermophilus?) ludovicianus* Richardson, Fauna Boreali-Amer., pt. 1, p. 154.

1829. *C[ynomys] cinereus* Richardson, Fauna Boreali-Amer., pt. 1, p. 155 (pro *grisea* Rafinesque, 1817).

1845. *Cynomys cinereus* Schinz, Syn. Mamm., II, p. 64 (syn.).

1855. *Monax missuriensis* Giebel, Die Säugethiere, p. 630 (syn.).

1857. *Cynomys ludovicianus* Baird, Gen. Rep. North Amer. Mamm., pp. xxv, 331.

1905. *Cynomys pyrrotrichus* Elliot, Proc. Biol. Soc. Washington, XVIII, p. 139, April 18. (White Horse Spring, Woods County, Oklahoma; type in Field Mus. Nat. Hist., Chicago.)

Type locality.—Upper Missouri River ("vicinity of the Missouri, and throughout the greater part of Louisiana").

Geographic distribution.—Great Plains region of western United States, south from near the Canadian border in Montana to west-central Texas (Mason County to eastern Pecos Valley); east to about the ninety-seventh meridian in Nebraska, Kansas, and Oklahoma; west to the Rocky Mountains in central Montana, Wyoming, and Colorado, and in extreme eastern New Mexico. Chiefly Upper Sonoran, but also ranging into Transition and Lower Sonoran Zones. Introduced colonies exist, or have been reported as formerly existing, in Sac County and at Burlington, Iowa; near Monroe, Louisiana; at Seneca, South Carolina; and on Nantucket Island, Massachusetts.

Characters.—Skull with superior surface of maxillary root of zygoma bordering premaxillary and frontal bones narrow, sharply emarginate anteriorly; audital bullæ comparatively small. Coloration in fresh summer coat less vinaceous-cinnamon than in *Cynomys ludovicianus arizonensis.*

Color.—Adult in full fresh summer pelage: Upperparts from nose to between eyes, between ears, nape, and over entire body above, dark pinkish cinnamon, finely lined with black and buff. Individual hairs black at base, followed by buffy white, then cinnamon, with subterminal band of buff, and, in unworn condition, narrow tip of blackish. Mixed with these are numerous wholly black and half-black hairs, rather longer than the ordinary pelage, the chief cause of black streaking. Upper lip, sides of nose, and eye ring buff or buffy white; whiskers black; cheeks and sides of head buffy or vinaceous-cinnamon, with numerous blackish hairs; arms above, sides of body, and legs above pale ochraceous-cinnamon; feet buffy. Tail above for about two-thirds its length like back, below paler vinaceous-cinnamon; terminal third chiefly black or blackish brown above and below, with extreme tip of lighter blackish brown. Underparts of body from chin to near tail whitish or buffy white. Nails blackish, tipped with light horn. Iris hazel. *Adult in full fresh winter pelage:* Pelage much thicker, softer, and longer than in the summer coat; less ochraceous or pinkish cinnamon, more buff and gray. Upperparts grayish cinnamon (mixed pale cinnamon, whitish, and black). Individual hairs intense black at bases, then pale buff, with subterminal band of cinnamon and tip of almost pure white. Mixed throughout this pelage, as in the summer coat, are numerous long overlying hairs of black. Forehead with considerable blackish; tail as in summer. Underparts dark buff or pale cinnamon, the hairs black at bases, whitish midway, and broadly tipped with pale cinnamon-buff. *Juvenile pelage:* Upperparts clear ochraceous-cinnamon, with admixture of a few white and blackish hairs; underparts whitish or pale buffy yellow; tail clear ochraceous-cinnamon, broadly penciled with black; bases of many of the black pencil hairs pure white.

Both the summer and the winter coats rapidly fade and wear, and the resulting variations in color are considerable. Specimens are frequently greatly affected by the color of the soil, and numerous examples are considerably reddened or darkened by stain, either on the upper and lower body or uniformly throughout the pelage. Specimens in complete fresh summer coat are rather uncommon as the vernal molt is so slow that the forward parts, renewed first, are already considerably worn before the tail, last to renew, is in full fresh coat.

Molt.—The spring molt and renewal are very conspicuous but the fall molt, especially in northern localities, is often obscure. There is considerable variation in the dates of renewal but the following schedule is about the average for northern and central Great Plains States: Late March and early April skins are worn, pale, and faded, but already show some signs of molt and renewal on the underparts, where the first new hair appears on the pectoral region and axillæ. May specimens have completely renewed below and the renewal has commenced on the head, shoulders, and in irregular patches on the back. June specimens are almost completely in fresh coat, but still show, as a rule, some of the old pelage on the rump and tail. July and early August skins are usually completely renewed, except for a few in which the tails above are still in the winter coat. The hair of the body is short and harsh, and rapidly becomes broken, worn, and faded. Late August adults show considerable progress in the fall renewal; the winter underfur and long soft hair is appearing on the lower back, and the animal looks generally lighter colored. The tails are fully renewed. November specimens are in complete new fur, and the hair on the tails still appears fresh and unworn after its single annual renewal; all traces of the summer coat have disappeared. In December skins, the coat has thickened, grown longer, and appears considerably lighter in color. This is in part due to fading, but is also caused by the general effect of the long white underfur showing through the reddish hair tips.

Skull and teeth.—The skull of *Cynomys ludovicianus ludovicianus* differs from that of *C. l. arizonensis* in its distinctly smaller audital bullæ and narrow, deeply emarginate anterior face of maxillary root of zygoma. It may readily be distinguished from skulls of *C. leucurus* (whose range meets that of *C. ludovicianus* in parts of Wyoming) by its slightly larger size, smaller bullæ, more notched anterior face of maxillary root of zygoma, less flattened zygoma (muscle attachment reaching farther forward, nearly or quite to plane of first tooth), generally heavier mandible, lighter postorbital processes, and small auditory meatus. The incisors vary in color from white to deep yellow in specimens from one locality. The variation in size and shape of skull among specimens of the same sex and age from one locality is remarkable (see Pl. VI).

Measurements.—Averages of 13 adult males from South Dakota: Total length, 388 (360–415); tail vertebræ, 86 (75–98); hind foot, 62 (61–83). *Skull:* Condylobasal length, 59.8 (57.2–62.6); zygomatic breadth, 45 (42.9–48.1); mastoid breadth, 28.5 (27.5–31); length of nasals, 23.8 (22–25); length of mandible, 45.9 (43–49.4); maxillary tooth row, alveoli, 16.6 (16–17.5). Females average very slightly smaller than males, but the difference in size is, as a rule, barely perceptible. For detailed measurements of specimens, see page 34.

Weight.—The weights of adult examples of *C. l. ludovicianus* are recorded in collectors' field catalogues as follows: Alma, Nebraska, October 21, ♂, 3 lbs., ♀, 2 lbs. 4 oz.; Tilyou's Ranch, Montana, October 1, ♀, 2 lbs. 3 oz.

Type specimen.—Ord's description of this prairie-dog was drawn from a stuffed skin in Peale's Museum, Philadelphia, supplemented by notes from the narrative of Lewis and Clark. This specimen was without doubt the identical skin which later on was more fully described by Say.[1] It has long since been lost sight of.

Remarks.—As explained in the account of the pelage changes, there is considerable seasonal color variation in the common prairie-dog, but a comparison of specimens in exactly the same state of pelage from all parts of the animal's range proves the absence of any constant geographical differences. There is likewise a remarkable uniformity in size, the averages and extremes of long series from northern States being virtually identical with measurements of specimens from Texas. The alleged form from Oklahoma, described by Dr. Elliot as *Cynomys pyrrotrichus*, is not subspecifically distinguishable from *C. l. ludovicianus*. Specimens from this region are commonly stained by the red soil, and sometimes so naturally as almost to defy detection as a stain. Numerous examples, however, show the telltale red soil on the toes and feet, and a careful microscopic examination of the hairs often shows the particles composing the stain, which can be perceptibly lightened by a moment's washing with alcohol or benzine. There are, furthermore, absolutely normally colored specimens from various parts of the area included in the distribution of the "red-haired" prairie-dogs, and all the young specimens are indistinguishable from juvenile examples from the Dakotas and other parts of the range of the species. Reddish skins, in all respects like the specimens of "*pyrrotrichus*" from Oklahoma, are not infrequently found in other parts of the prairie-dog's range where soil conditions are favorable for producing such a stain.

On the basis of skull characters the subspecies *ludovicianus* is typical over the northern parts of its general distribution, in Montana, the Dakotas, and Wyoming. The "area of intergradation" with *C. l.*

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[1] See Guthrie's Geog., 2d Amer. ed., p. 303, under "Columbia Marmot," where Ord states that "A stuffed skin of the Louisiana Marmot is in the Museum of Mr. Peale." Also, Say, in Long's Exped. to Rocky Mts., I, p. 452, 1823.

arizonensis is large, and skulls from Nebraska, Kansas, Oklahoma, and Texas are sometimes difficult to distinguish. As here mapped the range of *C. l. ludovicianus* includes the entire area where typical examples most frequently occur. The characters separating *arizonensis* are slight and are only average. For example, in an examination of 120 adult skulls from Montana, the Dakotas, Arizona, and Chihuahua, about 80 per cent can readily be placed with their proper form; comparing 115 skulls from Wyoming, Nebraska, and New Mexico, about 75 per cent are easily determinable; 31 skulls from Colorado and extreme western Texas (west of Pecos River) still show about 75 per cent readily distinguishable; while of 56 skulls from Kansas and Texas east of the Pecos, there are just about 50 per cent which can be differentiated, and the characters are relatively hard to distinguish satisfactorily.

An albinistic specimen, entirely white, from the Central Park Menagerie, New York, has been examined in the collection of the American Museum of Natural History.

Specimens examined.—Total number, 290, as follows:

Colorado: Boulder County, 1; Colorado Springs, 1;[1] Denver, 1; Don Carlos, 1; Fremont County, 1;[2] Larimer County, 4;[3] Loveland, 3; Monon (Baca County), 2;[1] Olney (Otero County), 4; Pueblo, 1; Rockvale, 2;[2] Soda Springs, 2;[4] Springfield, 2.[1]

Kansas: Arkansas River, 1; Banner, 8; Cairo, 2; Coyote Station, 1;[4] Fort Hays, 8;[4] Garden City, 2;[2] Garden Plain, 1; Hoxie, 1; Long Island, 3;[3] Pendennis (Lane County), 1; Republican River, 1; Trego County, 6.

Massachusetts: Nantucket, 2 (introduced).[4]

Montana: Billings, 1; Boxelder Creek, 1; Calf Creek, 1;[3] Craig (10 miles northwest of), 1; Darnall's Ranch, 1; Fort Assinniboine, 5; Fort Custer, 3; Glendive, 6; Great Falls, 2; Milk River (near mouth), 2; Newland, 2; Pompey's Pillar, Yellowstone River, 1; Shelby Junction, 4; Teton River, 2; Tilyou's Ranch, 1.

Nebraska: Alma, 2; Birdwood Creek, 3; Columbus (Platte County), 1; Kennedy, 3; Platte River, 4.

New Mexico: Chico Springs, 1; Koehler Junction, 2; Pecos, 1; Tompkin's Lake, 2.

North Dakota: Glenullin, 2; Little Missouri River, 1; Medora, 7.

Oklahoma: Beaver River, 4;[2,3] Chattanooga, 1; Mount Scott post office, 3; Neutral Strip, 5;[2,3] Ponca Agency, 2; White Horse Spring, 5 (including type of "*pyrrotrichus*").[2]

South Dakota: Armour, 1; Buffalo Gap, 8; Cheyenne River (Custer County), 2;[3] Corral Draw, 3;[3] Edgemont, 2; Fort Pierre, 6; Fort Pierre to Badlands, 15 (skulls); Fort Randall, 11; Phinney (Cheyenne River), 1; Pine Ridge Indian Reservation, 1;[2] Rapid City, 10; Upper Missouri River, 3 (skulls and skeletons).

Texas: Brazos River, 1; Colorado, 1; Fort Chadbourne, 1;[4] Henrietta, 4; Lipscomb, 1; Llano Estacado, 1; Mason, 9; Monahans, 1; Red River, 2; Stanton, 2; Texline, 1; Vernon, 11; Wichita Falls, 3.

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[1] Collection E. R. Warren.

[2] Collection Field Mus. Nat. Hist.

[3] Collection Amer. Mus. Nat. Hist.

[4] Collection Mus. Comp. Zool.

Wyoming: Arvada (Powder River Valley), 2; Camp Carling (=Fort Russell, near Cheyenne), 2; Cheyenne, 6; Deer Creek, 1; Douglas, 4; Fort Fetterman, 2; Ishawooa, 4; Newcastle, 4; Pine Bluff, 2; Pole Creek, 7; Sage Creek, 11.[1]

CYNOMYS LUDOVICIANUS ARIZONENSIS MEARNS.

ARIZONA PRAIRIE-DOG.

(Pl. I, figs. 2, 5; Pl. II, fig. 2; Pl. V, fig. 2.)

1890. *Cynomys arizonensis* Mearns, Bull. Amer. Mus. Nat. Hist., II, no. 4, p. 305, February 21.

1892. *C[ynomys] ludovicianus arizonensis* Merriam, Proc. Biol. Soc. Washington, VII, p. 158, July.

Type locality.—Point of Mountain, near Willcox, Cochise County, Arizona.

Geographic distribution.—Southeastern Arizona, southern and central New Mexico, southwestern Texas, and adjacent portions of Sonora and Chihuahua, Mexico. North to San Pedro and Santa Rosa, New Mexico; east to the Pecos Valley; west to Huachuca, Arizona; south to San Diego and Casas Grandes, Chihuahua, and to Presidio County, Texas.

Characters.—Like *Cynomys ludovicianus ludovicianus* but averaging very slightly larger, and brighter colored; skull with larger audital bullæ, and with superior surface of maxillary root of zygoma bordering premaxillary and frontal bones very broad, not deeply emarginate, the zygoma as viewed from above not branching at sharp angle from rostrum.

Color.—Almost precisely as in the typical subspecies, but averaging slightly brighter vinaceous-cinnamon in fresh summer pelage.

There is a single wholly melanistic specimen from south of the Guadalupe Mountains, in Texas, in the National Museum collection.

Molt.—Specimens showing excessive molt are more common than in the northern subspecies, and molting examples frequently exhibit strange patterns of coloration. There are frequent mixtures of the faded, left-over winter coat and the fresh reddish summer coat. Excessive wear before any renewal sometimes leaves large parts of the animal entirely black, the hair having been worn away completely except for the black underfur. Specimens in the much-worn pelage of late summer, before any evidence of fall renewal, frequently present a curious appearance: the color is pale ochraceous or yellowish buff and the hairs appear brittle and dead, often matted and twisted as if scorched by excessive heat.

January and February skins are in the long, soft, faded winter pelage. In the lower levels the spring molt occurs earlier than in the more northern race, and the animals are usually in full fresh summer coat, except for the tail, between the first part and middle of May. The short, stiff, summer coat rapidly wears and is much changed before the hair of the tail has renewed. At higher altitudes the pelage is not completely renewed until the middle of July. When the summer pelage is acquired this late the animals have molted again and renewed into full fall pelage by the first of October, while specimens from the lower levels, which acquired the summer pelage much earlier, are sometimes as late as November in attaining the same condition.

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[1] Collection Amer. Mus. Nat. Hist.

Skull and teeth.—The skull of *C. l. arizonensis* differs from that of *C. l. ludovicianus* in the very broad surface of the superior maxillary arm of the zygoma, bordering the ascending branch of the premaxilla and the frontal bone, which in the typical examples is nearly twice as wide as in *C. l. ludovicianus*, less sharply emarginate anteriorly, and rather more convex on the outer surface along the jugal. As a result the maxillary arm of the zygoma appears to leave the rostrum at a much less sharp angle than in the northern form. The audital bullæ average considerably larger than in typical *ludovicianus*. Teeth essentially as in the northern race.

Measurements.—Averages of 19 adult males from southeastern Arizona: Total length, 388 (350–412); tail vertebræ, 89 (78–100); hind foot, 62 (57–65). *Skull:* Condylobasal length, 60 (56.6–64); zygomatic breadth, 44 (41–47.2); mastoid breadth, 27.3 (26.1–29.5); length of nasals, 24 (22.3–25.4); length of mandible, 45.2 (42.8–47.2); maxillary tooth row, alveoli, 16.2 (15.5–17). Females average slightly smaller. For detailed measurements of specimens, see page 35.

Weight.—Three male specimens from Altuda, Texas, July 30, have the following weights recorded in collector's field catalogue: 2 lbs. 2 oz., 2 lbs. 6 oz., and 2 lbs. 8 oz.

Type specimens.—There are two cotypes, in the American Museum of Natural History, New York: Skin (No. 2509, ♀ ad.), from Point of Mountain, near Willcox, Arizona, April 9, 1885; and skin and skull (No. $\frac{2185}{1775}$, ♂ ad., teeth considerably worn), from Dragoon Summit, Arizona, May 3, 1885; both collected by Dr. Edgar A. Mearns. Dr. Mearns later[1] restricted the type locality to Point of Mountain, and listed No. $\frac{12162}{2509}$ as the type specimen. Two female specimens collected on the same date bear this skin number of the American Museum. One has a skull numbered 12162, but the other, without a skull number, bears a red type label, like No. 2185 from Dragoon Summit.

Remarks.—This is a slightly characterized form, barely recognizable except for average skull characters. Remarkable as it may seem, there are specimens from near the type region which can be matched in every particular with examples of typical *ludovicianus* from Montana. Nevertheless, as mentioned under the preceding form, about

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[1] Mearns, E. A., Bull. 56, U. S. Nat. Mus., p. 339, 1907.

80 per cent of the skulls examined from the two extremes are readily determinable. The very slight average increase in size and the slightly more vinaceous summer coat are of such trivial degree that alone they would be valueless as characters for subspecific separation. Throughout southeastern Arizona and over most of the New Mexican range of the form the skull characters are well marked, but in western Texas such a strong tendency toward *C. l. ludovicianus* appears as to make identification of single specimens or unsatisfactory series virtually impossible. I have therefore considered the range of the form restricted to the region from the Pecos Valley south and west, where 75 per cent or more of the skulls are determinable. The area of intergradation with the subspecies *ludovicianus* is so extensive (from Texas to Nebraska) that it is really larger than the range of either subspecies in its *typical* form.

Specimens examined.—Total number, 184, as follows:

Arizona: Bonita, 1; Dos Cabesos, 1; Dragoon Summit, 1 (cotype);[1] Fort Huachuca, 10; Huachuca Plains, 4;[2,3] Point of Mountain, 4 (including cotype);[1] San Pedro River, Mexican Boundary Line, 20;[4] Sulphur Spring Valley, 2;[1] Willcox, 13.

Chihuahua: Colonia Juarez, 5; Juarez, 2;[1,3] Sierra en Media, 1.

New Mexico: Animas Valley (Grant County), 14; Cactus Flat (20 miles north of Cliff), 4; Capitan Mountains, 3; Cliff, 1; Cloverdale, 3; Dog Spring (Grant County), 9; Faywood, 2; Gila (Grant County), 1; Hachita, 2; Jornada del Muerto, 1; Lake Valley, 3; Lone Mountain, 1; Manzano Mountains (east foothills), 2; Organ City, 1; Playas Valley, 1; Queen, 3; Roswell, 2; San Luis Springs (=Lang's ranch, Grant County), 26 (including 17 odd skulls); San Pedro, 3; Santa Rosa, 7; Silver City, 5.

Texas: Alpine, 1; Altuda, 3; Belen (El Paso County), 4; El Paso, 4; Fort Davis, 1; Guadalupe Mountains (near), 1; Limpia Mountains (=Davis Mountains), 1; Pecos River, 1; Presidio County, 2; Sheffield, 3; Sierra Blanca, 5

CYNOMYS MEXICANUS Merriam.

Mexican Prairie-Dog.

(Pl. I, fig. 3; Pl. II, figs. 3, 5; Pl. V, fig. 3; Pl. VII, fig. 2.)

1892. *Cynomys mexicanus* Merriam, Proc. Biol. Soc. Washington, VII, p. 157, July.

Type locality.—La Ventura, Coahuila, Mexico.

Geographic distribution.—Southeastern Coahuila and northern San Luis Potosi, Mexico. North to Saltillo; south to Vanegas.

Characters.—Size of *Cynomys ludovicianus*, but with longer tail; coloration above in summer coat less reddish, more grayish and vinaceous-buff, and much more heavily lined with black; coloration in winter still more hoary; black on terminal portion of tail much more extensive; teeth smaller.

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[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

[3] Collection Field Mus. Nat. Hist.

[4] Dr. Mearns tells me that a few of these specimens were actually collected on the Mexican side of the boundary line, in Sonora.

Color.—Adult in fresh summer pelage: Upperparts as in *C. ludovicianus,* but less reddish and much more grayish and vinaceous-buff; entirely black hairs more numerous, giving a much more grizzled general effect. Cinnamon areas less intense, more vinaceous. Tail above like rump for half its length; terminal half chiefly intense black, the black extending forward on sides of tail, leaving a lighter area midway; hairs of sides of pencil tipped with whitish, bases of all the pencil hairs almost pure white. *Adult in fresh winter pelage:* General appearance decidedly hoary or vinaceous-buff, the hairs with broad subterminal bands of whitish, which mix in the general effect with the narrow black tips and cinnamon undercolor. Individual hairs narrowly black at base, then broadly white and narrowly cinnamon, with subterminal band of buff and tip of blackish. The general effect is a glossy marbled vinaceous-buff, making the coat of this species by far the handsomest of all the prairie-dogs. *Juvenile* specimens are much paler than those of the corresponding age in *C. ludovicianus,* and rapidly change into a pelage like the fresh autumnal coat of adults.

Molt.—The molt of *C. mexicanus* is almost continuous and exceedingly complex, and without series of specimens collected in all the summer months it can not be worked out satisfactorily. With only March, April, July, and August skins before me I am inclined to believe that there are three complete renewals of the pelage of the body annually. Specimens collected in March have all renewed below, but are chiefly in the worn winter coat above, except in small areas forward, or even over the greater part of the head, shoulders, and withers, where renewal into a pelage much like the fresh winter coat has commenced. April skins from Saltillo are in a much-worn condition. The real summer pelage is certainly retained only a short time, as specimens collected at La Ventura from July 19 to August 5 exhibit every condition from what appears to be a worn, faded, left-over winter coat; through renewal into a short, stiff summer coat, without underfur; and the progress of the heavy winter pelage with a dense underfur over the posterior half of the back. Several specimens show all three of these pelages in definite areas on the body. Breeding females, as usual, are slow to renew, and the extreme state of wear is common until after the nursing season is over.

Skull and teeth.—Skull broad and angular, with wide-spreading zygomatic arches and sharply defined processes; in general effect more like skulls of *C. l. ludovicianus* from Montana and the Dakotas than like those of *C. l. arizonensis;* upper maxillary root of zygoma narrow along contact with ascending premaxillary bones and along ascending arm of jugal; face of upper incisors bright yellow. Differs from skulls of both *ludovicianus* and *arizonensis* in its much larger, greatly inflated auditał bullæ; teeth smaller; nasals broad and truncate posteriorly; triangular plate of jugal especially well developed and greatly produced at downward point; posterior border of inflected angle of mandible nearly at right angle with axis of jaw (in *ludovicianus* at an angle of about 45° with axis); the indistinct grooves along inner half of face of upper incisors usually more noticeable than in other forms.

Measurements.—Averages of 8 adult males from La Ventura, Coahuila: Total length, 416 (390–430); tail vertebræ, 102 (89–115); hind foot, 63 (59–68.5). *Skull:* Condylobasal length, 59.3 (58.4–60.5); zygomatic breadth, 44.6 (43–45.6); mastoid breadth, 28.6 (27.9–29.5); length of nasals, 23 (22.3–23.8); length of mandible, 43.8 (41.5–45.8); maxillary tooth row, alveoli, 15.9 (15.4–16.3). Females average slightly smaller. For detailed measurements of specimens, see page 35.

Type specimen.—No. $\frac{26422}{33876}$ U. S. National Museum, Biological Survey collection. Adult male, skin and skull (teeth moderately worn). Collected March 24, 1891, by C. P. Streator; original number 625. Except for the underparts, head, nape, and shoulders, which are in process of renewal, the specimen is in the worn, left-over winter pelage.

Remarks.—This is a well-marked species, easily distinguishable externally and by skull characters from the other forms of the genus. It is no more closely related to *Cynomys ludovicianus arizonensis* than to typical *ludovicianus*, and the southern subspecies *arizonensis* can not be considered as intermediate in the true sense between it and *ludovicianus*. In the excessive size of the auditał bullæ, *mexicanus* is the extreme of the *arizonensis* type, but in other characteristics it more closely resembles *ludovicianus*, and is separated from both by a number of constant differences. It is completely isolated in its distribution from other forms of *Cynomys* and occupies only a limited range.

Specimens examined.—Total number, 42, as follows:

Coahuila: La Ventura, 37 (including type); Saltillo, 5.[1]

Subgenus LEUCOCROSSUROMYS nov.

Characters.—Size slightly smaller than in the subgenus *Cynomys*, general appearance more spermophile-like; tail short, averaging less than one-fifth the total length, and tipped with white; mammæ normally 10, rarely 12. *Skull:* General shape of occipital region, viewed from behind, elliptical-oval; jugal bone weak, thin, and flat, the outer surface at angle of ascending branch only very slightly thickened, the margin rounded, not triangular; maxillary root of zygoma correspondingly weak, the shelf and suprajugal arm not especially thickened. Teeth smaller than in the subgenus *Cynomys*, not so much expanded laterally.

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[1] Collection Mus. Comp. Zool.

Type species.—*Cynomys gunnisoni* (Baird).

Remarks.—The mountain-inhabiting group of prairie-dogs commonly known as the "white-tailed" species form a compact group clearly separated from the typical subgenus. It includes three well-marked species, *leucurus*, *parvidens*, and *gunnisoni*. In habits these are distinctly spermophile-like and in coloration they are peculiar. All have sharply marked areas of color above the eye and on the cheek, and have the tail tipped or bordered with white.

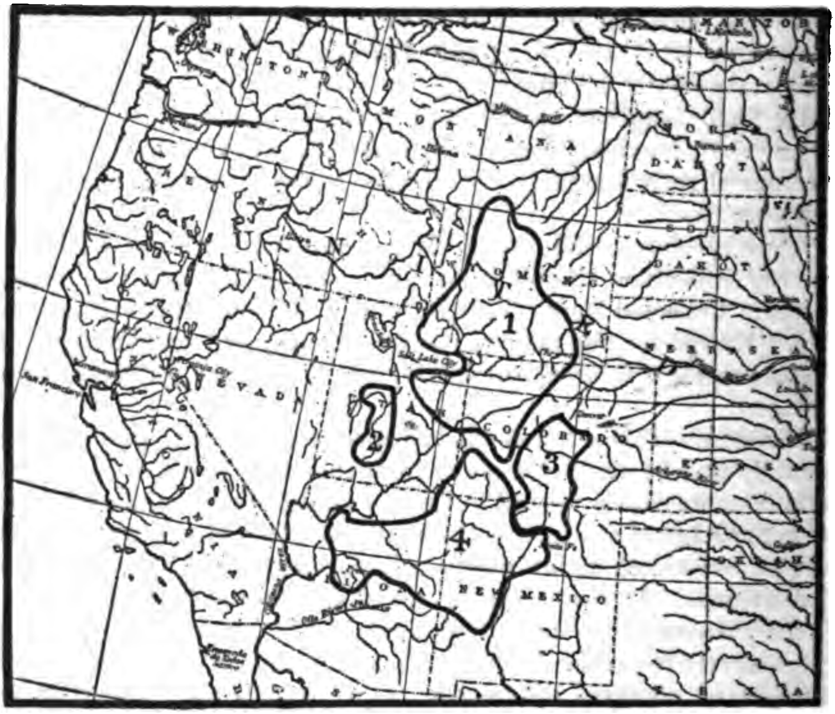

FIG. 2.—Distribution of subgenus *Leucocrossuromys*: 1, *Cynomys leucurus*; 2, *C. parvidens*; 3, *C. gunnisoni gunnisoni*; 4, *C. g. zuniensis*.

CYNOMYS LEUCURUS Merriam.

White-Tailed Prairie-Dog.

(Pl. III, fig. 1; Pl. IV, fig. 1; Pl. VII, fig. 5.)

1874. *Cynomys columbianus* Allen, Proc. Boston Soc. Nat. Hist., XVI, p. 294 (part; not *Arctomys columbianus* Ord, 1815).

1890. *Cynomys leucurus* Merriam, North Amer. Fauna No. 3, p. 59, September 11; North Amer. Fauna No. 4, p. 33, October 8.

1898. *Cynomys lewisii* Allen, Bull. Amer. Mus. Nat. Hist., X, p. 456, November 10 (not *Arctomys lewisii* Audubon and Bachman, 1854).
1904. *Cynomys lewisi* Trouessart, Cat. Mamm., suppl., p. 342.

Type locality.—Fort Bridger, Sweetwater County, Wyoming.

Geographic distribution.—Irregular areas in the mountainous parts of Montana, Wyoming, Utah, and Colorado. South from the Bighorn Basin, in southern Montana, across central and southwestern Wyoming into western Colorado and northeastern Utah; east to the Laramie Mountains, Wyoming, and into North Park, Colorado; south into the lower Gunnison Valley; west a few miles across the Bear River Divide into extreme northern Utah and, farther south, into the Green River valley. Chiefly Transition Zone.

Characters.—Size, largest of the subgenus, only slightly smaller than in *Cynomys ludovicianus*, but tail much shorter; general coloration less reddish, more grayish buff than in *C. parvidens;* differs from *C. gunnisoni* in having terminal half of tail entirely white; supraorbital spot and cheek dark brown.

Color.—*Adult in fresh summer pelage:* General color of upper parts yellowish buff, streaked with blackish. Nose yellowish buff, unmarked; spot above eye and large area on cheek dark blackish brown; ears pale cinnamon. Top of head to center of tail uniformly mixed pale cinnamon-buff or yellowish buff and blackish; the individual hairs black at bases, then light gray, then pale cinnamon, with subterminal band of buff and, in unworn condition, tip of blackish. Limbs, feet, and underparts clear buffy; nails blackish, tipped with light horn. Tail white, the hairs of proximal half above with bands of blackish, below pale cinnamon; distal half clear white. *Adult in fresh winter pelage:* Decidedly darker than in summer; more blackish above, especially posteriorly; the buff tints richer in tone and the dark areas on head considerably spread out, less sharply defined. There is a heavy underfur of grayish white, but the bases of all the hairs are clear black; sides of nose, chin, and throat white; nape and flanks lighter, more grayish, than back and rump. *Juvenile pelage:* Above grayish brown; below paler grayish; supraorbital spot of brownish black sharply marked. *Postjuvenile pelage:* Specimens in first fresh autumnal coat darker than adults, more reddish, and hairs of upperparts more heavily tipped with blackish.

Adults in the faded, left-over winter coat are often very yellowish above, with little or no black streaking from the hair tips. Many specimens in various stages of molt and renewal present strange combinations of color. Examples deeply stained by color from the soil are frequently noted.

Molt.—The two annual molts are greatly affected by altitude, with a consequent variation of a month or more in near-by localities. In Wyoming the molt is approximately as follows: Specimens taken before May 10 are still in the old winter coat, with little evidence of molt. Skins collected from May 20 to June 1 have renewed over most of the underparts and somewhat on the head and shoulders. Numerous examples taken from June 1 to 10 are all in fresh coat except on the lower rump and tail. Skins collected July 15 to 30 are in full summer coat. By August 10 there is much evidence of wear over the forward half of body, and by early September the fall renewal has commenced. As in the case of *C. ludovicianus*, this progresses forward, and by September 25 to October 1 is complete.

Skull.—Larger than in *C. parvidens* or *C. gunnisoni;* otherwise much like skull of *parvidens* but with narrower interorbital region. Differs further from skull of *gunnisoni* in the less broadly spreading maxillary arm of zygoma, large and flat mastoids, larger audital bullæ, and less rounded inferior rim of angle of ascending branch of jugal; occiput viewed from behind broader and flatter.

Measurements.—Averages of 13 adult males from Wyoming: Total length, 358 (340–370); tail vertebræ, 57 (44–60); hind foot, 62 (60–65). *Skull:* Condylobasal length, 58.7 (56–61.3); zygomatic breadth, 43.8 (41.7–45.4); mastoid breadth, 29 (27.4–30); length of nasals, 22 (20.7–23.1); length of mandible, 43.1 (41.6–44.9); maxillary tooth row, alveoli, 15.7 (15.1–16). For detailed measurements of specimens see page 35.

Type specimen.—No. 186472, U. S. National Museum. Adult female, skin and skull (teeth moderately worn). Collected September 15, 1888, by Vernon Bailey; original number 224 (Merriam collection, skin 4668, skull 5319). In worn summer coat anteriorly and in fresh winter coat posteriorly.

Remarks.—In 1898, Dr. J. A. Allen[1] proposed that the name *Arctomys lewisii* of Audubon and Bachman be revived for this species. The specimen on which *Arctomys lewisii* was founded was recorded as No. 461 of the Zoological Society of London collection. In reply to my inquiry as to the possible existence of this type specimen in the British Museum, Mr. Oldfield Thomas wrote, under date of January 6, 1915, that the specimen is still preserved, is numbered 55.12.24.144 of the Museum register, but that it is a species of *Marmota,* and not of *Cynomys* as supposed by Dr. Allen.

The ranges of *Cynomys leucurus* and *C. gunnisoni* are not known actually to meet, but the ranges of *C. leucurus* and *C. ludovicianus* do meet, and for a short distance overlap, at several points in Montana and Wyoming. Both species are constantly enlarging their ranges, pushing out into new valleys, and consequently frequently find themselves in close proximity. Individuals of one species sometimes wander into villages of the other. In the Bighorn Basin, in Montana, Bailey found the species living in close proximity but always apart, although there was no natural barrier. Cary found them intermingling in colonies near Ishawooa, Wyoming, and Bailey captured a specimen of *leucurus* in a "town" of *ludovicianus* in Clark's-Fork valley, Montana.

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[1] Bull. Amer. Mus. Nat. Hist., X, p. 456, 1898.

Except for what appears to be a slight average increase in size in the extreme southern portions of its range, the specimens of *C. leucurus* that have been assembled present a remarkably uniform appearance, both in coloration and in skull characters. There has been considerable misunderstanding in times past as to the western limit of distribution of this species. Many writers believed that its range extended to the Plains of the Columbia, and this mistake is one of the principal reasons for past confusion in nomenclature. As a matter of fact the animal is entirely unknown in Idaho, and crosses the Bear River Divide to the Wyoming-Utah boundary at only one place, so far as known. Regarding this western limit of distribution, Dr. Merriam has given me an interesting note. He tells of tracing the species, in 1913 and 1914, across the Utah-Wyoming boundary not far from Evanston, westward into Utah for a distance of six or seven miles where it stops abruptly.

Specimens examined.—Total number, 107, as follows:

Colorado: Beaver Creek to bridge over White River (Rio Blanco County), 2;[1,2] Big Beaver Creek, 2;[1] Buford, 1; Canadian Creek, 2; Coyote Basin, 1;[1] Craig to Kelly's (Moffat County), 4;[1] Crawford, 1;[1] Douglas Spring, 1;[1] Escalante Hills, 1; Grand Junction, 17; Hayden, 1; Hebron, 1; Hell Creek (Jackson County), 1;[1] Meeker, 4; North Park, 1; Sand Creek to Snake River, 2.[1,2]

Montana: Clark's Fork, 1; Sage Creek, 2.

Utah: Uinta Mountains, 1;[3] Uncompahgre Indian Reservation, 3.[2]

Wyoming: Bear Creek, 1; Bighorn Basin, 1; Big Piney, 1; Big Sandy, 1; Bridger's Pass, 1; Cheyenne (west of), 2; Cumberland, 2; Deer Creek, 2; Dubois, 1; Fontenelle, 1; Fort Bridger, 10 (including type); Fort Steele, 2; Fossil, 1; Garrett, 2; Green River, 2; Independent Rock (25 miles southwest of), 1; Ishawooa, 1; Lander, 3; Laramie Mountains, 2; Lost Cabin, 1; Medicine Bow Mountains, 4; New Fork of Green River, 6; Otto, 1;[2] Pole Creek, 1; Shirley Mountains, 1; Spring Creek, 1; Sweetwater, 1; Woods Post Office, 5.

CYNOMYS PARVIDENS ALLEN.

UTAH PRAIRIE-DOG.

(Pl. III, fig. 2; Pl. IV, fig. 2; Pl. V, fig. 4; Pl. VII, fig. 4.)

1905. *Cynomys parvidens* Allen, Science Bull., Mus. Brooklyn Inst. Arts and Sci., I, no. 5, p. 119, March 31.

Type locality.—Buckskin Valley, Iron County, Utah.

Geographic distribution.—Mountain valleys of central Utah in the Sevier River region; south from Nephi to Iron and Garfield Counties.

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[1] Collection E. R. Warren. [2] Collection Amer. Mus. Nat. Hist. [3] Collection Mus. Comp. Zool.

Characters.—In general like *Cynomys leucurus* but smaller and with color of upperparts in summer and winter decidedly reddish or rich cinnamon, less buffy or grayish; tail with terminal half white, as in *leucurus*. Skull as in *leucurus*, but smaller, with greater interorbital breadth.

Color.—*Adult in late summer:* Entire upperparts of head and body cinnamon or dark buffy cinnamon, with very little admixture of buff or blackish hairs; the individual hairs blackish at bases, then narrowly pale buff, broadly cinnamon, and tipped with dark brown. Spot of black above eye very sharply marked; cheek patch of brown distinct; sides of nose pale buff; eye ring, ears, and limbs cinnamon; feet dark buff; lips and chin whitish; underparts buffy or cinnamon. Tail for half its length above concolor with rump; below cinnamon; terminal half all around white, without markings. *Adult in early winter pelage:* In general like summer coat but with dense underfur which is black at base, then light buff; upperparts rich cinnamon, the long hairs with broad bands of black and buff; sides of body yellowish buff, distinctly marked from color of back, and streaked by the bands of black on the longer overlying hairs.

Molt.—Owing to lack of material collected at certain seasons, the molt of *C. parvidens* is not well known. A single skin collected in the Sevier National Forest, May 19, is still entirely in the old winter coat. Specimens collected in late August and early September are mostly in rather worn summer coat, with little indication of molt. The tails are in freshly renewed pelage. Some specimens, taken the first week in September, are well advanced in renewal of winter pelage, with full underfur and long, fresh coat. Evidently the transition from summer to winter coat is gradual and obscure, without a distinct molt, much as in the animals of the northern part of the ranges of *C. ludovicianus* and *C. leucurus*. A series of skins collected in the Sevier National Forest, October 27 to November 3, are in full winter coat.

Skull and teeth.—Skull much like that of *C. leucurus*, but smaller and with greater interorbital breadth; postorbital processes less abruptly projecting. The teeth are not noticeably smaller.

Measurements.—Averages of 8 adult males from Utah: Total length, 338 (305–360); tail vertebræ, 43 (30–57); hind foot, 59 (55–61). *Skull:* Condylobasal length, 55.9 (53–57.9); zygomatic breadth, 42.2 (38.3–44.5); mastoid breadth, 28.6 (26.7–29.8); length of nasals, 21.8 (20.5–22.4); length of mandible, 42.3 (40.3–43.7); maxillary tooth row, alveoli, 15 (14.8–15.4). For detailed measurements of specimens see page 35.

Type specimen.—No. 28738, American Museum of Natural History, New York. Adult not sexed, but probably a male; skin and skull (teeth moderately worn). Collected August 25, 1904, by George P. Engelhardt, on the Brooklyn Institute of Arts and Sciences expedition of 1904 (Museum of Brooklyn Institute No. 437). Skin in good condition, but not made up into a modern study specimen. It is in worn summer pelage, but with freshly renewed coat on the tail.

Remarks.—The relationship of this distinct species with *Cynomys leucurus* rather than with *C. gunnisoni* is clear. No evidence of intergradation with *leucurus* is found in the material of each form which I have examined, and every specimen of *C. parvidens* can instantly be distinguished by its marked reddish coloration. The superficial resemblance to certain specimens of *C. g. zuniensis* is striking, but the color of the tail and general skull characters are diagnostic. Specimens of this prairie-dog from many parts of its range and collected at all seasons, particularly early summer and late fall, are much needed.

Specimens examined.—Total number, 46, as follows:

Utah: Buckskin Valley, 18 (including the type[1] and paratype[1]); Sevier National Forest, 28.

CYNOMYS GUNNISONI (Baird).

[Synonymy under subspecies.]

Characters.—Smaller than *Cynomys leucurus*; larger than *C. parvidens;* general coloration darker; tail gray, with white tip and white border on the terminal half (in *leucurus* and *parvidens* the terminal half of tail is entirely white). Skull smaller than in *leucurus*, larger than in *parvidens;* differs from both in more broadly spreading maxillary arm of zygoma; mastoids smaller and more obliquely placed, rather than in general occipital plane; audital bullæ smaller; occiput viewed from behind higher and less broadened; inferior rim of angle of ascending branch of jugal averaging less pointed, more rounded, with little trace of special lateral flattened surface.

Subspecies.—Two subspecies of *Cynomys gunnisoni* are here recognized. The typical race is confined to parts of Colorado and northern New Mexico, while a paler desert form, *C. g. zuniensis*, ranges from central New Mexico and southwestern Colorado to the San Francisco Mountain region and to the Hualpai Indian Reservation, Arizona.

CYNOMYS GUNNISONI GUNNISONI (Baird).

Gunnison Prairie-Dog.

(Pl. III, fig. 3; Pl. IV, fig. 3; Pl. V, fig. 5; Pl. VII, figs. 3, 6.)

1855. *Spermophilus gunnisoni* Baird, Proc. Acad. Nat. Sci. Philadelphia, VII, p. 334, April.

1857. *Cynomys gunnisonii* Baird, Gen. Rep. North Amer. Mamm., pp. xxv, 335.

1877. *Cynomys gunnisoni* Allen, Proc. Boston Soc. Nat. Hist., XVI, p. 294 (syn.).

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[1] Collection Amer. Mus. Nat. Hist.

Type locality.—Cochetopa Pass, Saguache County, Colorado.

Geographic distribution.—Rocky Mountain region of central and central-southern Colorado and northern New Mexico. North into South Park, Colorado; east to El Paso, Fremont, and Huerfano Counties, Colorado; south into the Sangre de Cristo and Jemez Mountains, New Mexico; west to western Gunnison and Hinsdale Counties, Colorado, and to western Rio Arriba County, New Mexico. Chiefly Transition Zone, but also in Upper Sonoran and lower parts of Canadian Zone.

Characters.—Slightly smaller than *Cynomys gunnisoni zuniensis*, with smaller hind foot; coloration more buffy and blackish, less pinkish cinnamon and ochraceous. General coloration much as in *C. leucurus*, but averaging darker, and with only tip and border of terminal half of tail white.

Color.—*Adult in fresh summer pelage:* General coloration, except for tail, very much as in *C. leucurus*, but darker; averaging more drab, less yellowish, and the cheeks less sharply marked by dark patch. Tail for proximal half above concolor with back; distal half dark gray, bordered and tipped with white, and with subterminal band of blackish; underside of tail pale cinnamon, blending into white at tip, and edged with white. The fresh spring coat, which is glossy and much intermixed with blackish, rapidly turns a dull brown, the jet black hair tips having worn away or faded. *Winter pelage*, except for the tail, much like that of *leucurus*.

Molt.—There is a variation of about six weeks in the time of molt, according to altitude, but the average dates in Colorado are about as follows: Spring specimens are in the left-over winter coat or in various degrees of molt up to June 10 or July 1, when the pelage, with the exception of the tail, is entirely renewed. A fews pecimens have completely renewed the pelage on the tail as early as July 15, but numerous examples collected as late as August 10, still have the tail clothed in the old winter hair. The fresh coat rapidly loses its luster, and during the latter half of August the pelage becomes much worn over the anterior half of the body while the posterior half shows considerable influx of new hair. The molt is usually complete and the animal in full fresh coat again by September 15. Mid-October skins are in full long coat, with a dense underfur.

Skull.—Averaging smaller and of less robust build than skull of *C. g. zuniensis*. Readily distinguishable from skulls of *C. leucurus* by its considerably smaller size (see also specific skull characters, page 29).

Measurements.—Averages of 12 adult males from Saguache County and Fort Garland, Colorado: Total length, 340 (309–365); tail vertebræ, 53 (39–65); hind foot, 56 (52–59). *Skull:* Condylobasal length, 54.8 (52.4–56.5); zygomatic breadth, 42.5 (40.7–44.2); mastoid breadth, 27 (25.7–28.2); length of nasals, 20.5 (18.9–22.3); length of mandible, 41.9 (40.9–43.3); maxillary tooth row, alveoli, 14.5 (14–15). Females average slightly smaller. For detailed measurements of specimens see page 35.

Weight.—An adult male collected September 6 in the Jemez Mountains, New Mexico, weighed 1½ pounds.

Type specimen.—No. 1636, U. S. National Museum. Skull of young adult, not sexed (teeth little worn). Collected in September, 1853, by F. Kreutzfeldt; original number 22. The museum catalogue shows that the skin (No. 501) was formerly preserved in the collection, but it has been lost for many years.[1]

Remarks.—So far as known the ranges of *Cynomys gunnisoni* and *C. leucurus* do not actually meet at any point, although, as stated by Cary,[2] they are separated by only a very narrow strip in the Cimarron region. Though so much alike in general characters the two species seem perfectly distinct, with no evidence of intergradation. While chiefly a Transition Zone form, *gunnisoni* is common and at home in the Upper Sonoran valleys within its range, as throughout suitable places in the upper Rio Grande and San Luis Valleys, Colorado. The range of *gunnisoni* nearly if not quite meets that of the black-tailed prairie-dog at several points in the eastern foothill region of Colorado. Prof. Lantz noted a colony of *gunnisoni* in South Park, Colorado, in which black and partly black individuals were common, a dozen or more melanistic specimens being seen.

This dark form of *C. gunnisoni* intergrades directly with the paler race, next described, of the more arid parts of New Mexico and Arizona, but the two subspecies are well marked and the area of intergradation is small.

Specimens examined.—Total number, 111, as follows:

Colorado: Antonito, 2; Cascade, 1; Castrel's Ranch (Park County), 2;[3] Cochetopa Pass, 30 (including type skull); Colorado City (northwest of), 3;[3] Colorado Springs (west of), 1; Divide (Teller County), 2;[4] Florissant, 2;[4] Fort Garland, 20 (including some older skins labeled "Fort Massachusetts"); Fremont County, 2;[5] Head of Rio Grande, 1;[6] Pike's Peak, 3; Poncha Pass, 2;[4] Querida, 2;[4] Saguache, 4; Salida, 5;[4, 6] Southfork, 2; Tarryall Creek (Park County), 1;[4] Twin Creek, 1;[3] Twin Lakes, 1; Wagon Wheel Gap, 12.[3, 4, 6]

New Mexico: Costilla Pass, 3; Coyote Creek, 2; Gallinas Mountains, 1; Jemez Mountains, 1; La Jara Lake, 1; Moreno Valley, 2; Tres Piedras, 2.

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[1] See Lyon and Osgood, Bull. 62, U. S. Nat. Mus., pp. 161–162, 1909.

[2] North Amer. Fauna No. 33, p. 95, 1911.

[3] Collection Mus. Comp. Zool.

[4] Collection E. R. Warren.

[5] Collection Field Mus. Nat. Hist.

[6] Collection Amer. Mus. Nat. Hist.

CYNOMYS GUNNISONI ZUNIENSIS SUBSP. NOV.

ZUNI PRAIRIE-DOG.

(Pl. III, fig. 4; Pl. IV, fig. 4; Pl. V, fig. 6.)

Type locality.—Wingate, McKinley County, New Mexico.

Geographic distribution.—Southwestern Colorado, extreme southeastern Utah, northwestern and west-central New Mexico, and north-central Arizona. North in western Colorado to Montrose County; northeast in New Mexico in the Rio Grande Valley to Espanola and east to Pecos and the Manzano Mountains; south on the west side of the Rio Grande Valley to Sierra and Socorro Counties, New Mexico; west in central Arizona to Prescott and the Hualpai Indian Reservation. Chiefly Upper Sonoran, but also in Transition Zone.

Characters.—Slightly larger than *Cynomys gunnisoni gunnisoni*, with larger hind foot and heavier skull. Coloration less buff and blackish, more pinkish cinnamon and ochraceous.

Color.—*Adult in fresh summer pelage:* General color of upperparts pale cinnamon, heavily streaked with lighter cinnamon-buff and blackish; individual hairs blackish at bases, then narrowly buff, then broadly cinnamon, with subterminal band of buff, and tip of blackish. Nose, lips, eye ring, and ears, buff; between eyes, between ears, and over nape darker brown, mixed with blackish; large area of blackish brown on cheek, and a smaller, sharply marked, blackish brown spot above eye; feet, limbs, and underparts pale cinnamon-buff. Basal half of tail above concolor with back; distal half mixed gray and white, bordered and tipped with clear white. The black tips to the hairs of the back rapidly wear away and the pelage becomes a uniform dull cinnamon, mixed with light buff. The distinctive markings of the head become more obscure. *Adult in fresh full winter pelage:* General color more grayish and buff, less cinnamon, than in summer, with greater admixture of blackish hairs on head and more of white and gray on body. General color of upperparts dark cream-buff, heavily mixed with pale buff and blackish, giving a decided grizzled appearance; underfur narrowly black, then broadly whitish; the long hairs with bands of black, pale cinnamon, and white, and narrow tips of black. Top of head and cheeks heavily intermixed with blackish, the spot over eye sometimes intense black; sides of nose, eye ring, ears, limbs, and sides of body rich cream-buff; lips and throat paler; underparts pale cinnamon. Tail above mixed gray and white, with a narrow sub-border of dark gray and border of clear white; below clear pale cinnamon, terminal half with faint sub-border of grayish brown and border and tip of creamy white. *Young* examples in the fresh postjuvenile pelage are more vinaceous or pinkish cinnamon than the corresponding pelage of *C. g. gunnisoni*.

Molt.—The molt of *C. g. zuniensis* is much more conspicuous than in the northern subspecies. May specimens are frequently in a very ragged state, with very little indication of renewal. Specimens in complete summer coat, including the tail, are rarely taken before July 1. The summer coat frequently is so rapidly worn and bleached as to change the entire appearance of the animal before there are any traces of the fall pelage. The new pelage of autumn first appears in adults over the posterior half of the body about September 1. No specimens in full winter coat have been seen which were killed earlier than November 1.

Skull.—As in *C. g. gunnisoni* but averaging larger and more heavily built.

Measurements.—Type specimen: Total length, 363; tail vertebræ, 53; hind foot, 60. *Skull:* Condylobasal length, 57.9; zygomatic breadth, 43.8; mastoid breadth, 29.1; length of nasals, 22.4; length of mandible, 43; maxillary tooth row, alveoli, 15.6. Averages of 9 specimens from Arizona: Total length, 355 (330–373); tail vertebræ, 62 (54–68); hind foot, 60 (57.5–62.5). *Skull:* Condylobasal length, 55.8 (51.9–57.8); zygomatic breadth, 43.5 (39.7–45.5); mastoid breadth, 27.4 (25.7–28.6); length of nasals, 21.9 (20.6–23.5); length of mandible, 42.7 (40.3–44.2); maxillary tooth row, alveoli, 14.5 (14.2–14.8). For detailed measurements of specimens see page 35.

Weight.—An adult male collected at Acoma, New Mexico, September 28, weighed 2 pounds.

Type specimen.—No. 137555, U. S. National Museum, Biological Survey collection. Adult male, skin and skull (teeth considerably worn). Collected at Wingate, New Mexico, June 26, 1905, by N. Hollister; original number 2374. Except on the tail the skin is in fresh summer pelage.

Remarks.—This well-marked-color subspecies of *Cynomys gunnisoni* occupies the arid southwestern part of the range of the species and is the common prairie-dog of large parts of New Mexico and Arizona. Material from southwestern Colorado is not plentiful, but the specimens examined indicate that the range of the pale form extends into that portion of the State. Specimens are wanting from the near-by section of Utah, where this form undoubtedly occurs. Specimens from Flagstaff, Arizona, and the vicinity of San Francisco Mountain in general are slightly darker, more drab, than skins from eastern Arizona and western and central New Mexico, but on the whole the form is very uniform in coloration throughout its range. While in the main an Upper Sonoran form, this prairie-dog is generally distributed in the Transition Zone parks of numerous mountain ranges. In the Bear Spring Mountains, New Mexico, in 1905, I saw one nearly pure-white animal of this species. Bailey reports finding a mixed colony of individuals of this form and of *C. ludovicianus* near Pecos, New Mexico, and he captured specimens of each form at San Pedro, but the ranges of the two species rarely overlap.

Specimens examined.—Total number, 96, as follows:

Arizona: Agua Fria, 4;[1] Aubrey Valley, 1; Clarks Valley, Mogollon Mountains, 2;[1] Flagstaff, 7; Keams Canyon, 1; Kendrick Park, 4; Little Spring, 6; Mormon Lake, 5; San Francisco Mountain, 7; Spaulding's Ranch, Agua Fria Valley, 1;[1] Springerville, 13, Winslow, 2.

Colorado: Bedrock, 2;[2] Cortez, 1;[1] Coventry, 1.[2]

New Mexico: Acoma, 1; Albuquerque, 7; Chusca Mountains, 2; Espanola, 2; Fairview, 2; Fruitland, 1; Liberty, 1; Magdalena, 3; Manzano Mountains, 1; Ojo Caliente, 2; Pecos, 3; Rio Alamosa, 3; San Augustine Plain, 2; San Mateo Mountains (Socorro County), 1; San Pedro, 1; San Rafael, 1; Thoreau, 2; Wingate, 3; Zuni Mountains, 1.

TABLES OF MEASUREMENTS.

Adult male specimens of Cynomys.

Species and locality.	Museum number.	Skin.			Skull.				Condition of molar teeth.
		Total length.	Tail vertebræ.	Hind foot.	Condylobasal length.	Zygomatic breadth.	Mandible.	Maxillary tooth row.	
C. ludovicianus ludovicianus.									
Montana:									
Shelby Junction	66690	375	72	55	59.1	44.7	45.5	16.2	Moderately worn.
Do	66691	374	85	60	59.0	44.4	45.3	15.9	Do.
Darnall's Ranch	169447	410	95	65	62.5	46.6	47.7	16.9	Do.
North Dakota: Medora	161314	405	96	64	61.4	45.5	45.9	16.9	Much worn.
South Dakota:									
Fort Pierre	191426	373	76	62	61.0	45.2	45.8	16.8	Considerably worn.
Buffalo Gap	191428	384	90	63	60.8	43.8	46.4	16.8	Moderately worn.
Do	191429	360	84	61	59.5	42.9	45.0	16.6	Do.
Wyoming:									
Ishawooa	169493	396	93	64	60.6	45.2	45.8	17.0	Do.
Newcastle	65894	390	79	62	60.9	44.2	46.7	16.8	Do.
Nebraska:									
Kennedy	191427	392	78	57	61.4	44.8	46.1	16.8	Do.
Do	18678	390	92	63	59.2	45.7	44.8	16.5	Do.
Alma	110770	409	89	65	62.1	47.0	48.1	17.2	Do.
Colorado:									
Loveland	69521	370	82	62	60.2	45.5	46.0	17.1	Considerably worn.
Olney	69952	379	83	61	59.6	44.1	45.5	17.0	Moderately worn.
Do	70020	355	82	61	57.2	43.1	43.9	16.9	Do.
Kansas: Pendennis	87627	371	81	62	60.3	47.2	46.2	16.9	Considerably worn.
Oklahoma:									
Mount Scott	132440	375	115	63	61.5	44.2	47.2	17.3	Moderately worn.
Do	132441	376	104	63	59.6	44.8	45.9	17.0	Do.
Texas:									
Vernon	64783	365	82	61	60.6	44.4	46.4	16.8	Considerably worn.
Do	64784	413	93	60	63.6	48.1	47.3	16.6	Do.
Henrietta	64780	386	87	66	62.0	45.3	48.4	17.0	Moderately worn.

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[1] Collection Amer. Mus. Nat. Hist.

[2] Collection E. R. Warren.

Adult male specimens of Cynomys—Continued.

Species and locality.	Museum number.	Skin.			Skull.				Condition of molar teeth.
		Total length.	Tail vertebræ.	Hind foot.	Condylobasal length.	Zygomatic breadth.	Mandible.	Maxillary tooth row.	
C. ludovicianus arizonensis.									
Texas:									
Altuda	23183	398	96	64	61.5	45.0	46.0	16.7	Moderately worn.
Do	23184	400	92	62	60.8	46.2	47.5	16.7	Do.
Do	23396	404	89	67	61.7	46.4	47.4	16.8	Much worn.
New Mexico:									
Silver City	51279	380	79	61	60.9	47.0	45.0	16.1	Do.
Dog Spring	20380	412	94	66	62.2	44.3	45.7	16.9	Do.
Animas Valley	58920	395	83	64	59.9	44.5	44.2	16.0	Do.
Chihuahua: Sierra en Media	99362	400	80	65	62.9	45.0	46.0	16.6	Do.
Arizona:									
Fort Huachuca	34029	412	97	60	61.8	45.2	46.8	16.6	Considerably worn
Do	34030	410	100	64	62.8	45.0	44.9	16.1	Much worn.
Do	34031	400	93	62	62.3	44.1	45.9	16.5	Do.
C. mexicanus.									
Coahuila:									
La Ventura	[1] 26423	419	107	63	59.2	45.6	43.9	16.3	Moderately worn.
Do	26426	430	106	64	59.9	45.0	43.9	15.5	Do.
Do	26428	415	103	61	59.5	44.7	44.0	15.9	Do.
Do	26429	415	102	59	58.5	43.0	42.8	15.8	Do.
Do	79546	415	115	64	58.7	44.4	45.8	15.4	Do.
C. leucurus.									
Wyoming:									
Ishawooa	169336	370	60	60	60.3	45.4	44.3	15.6	Much worn.
Spring Creek	56002	363	60	60	58.7	43.6	43.0	15.4	Moderately worn.
Fontenelle	147187	370	48	62	61.3	45.0	44.9	16.0	Much worn.
Cumberland	179515	368	60	63	59.9	44.4	44.6	15.9	Do.
Fort Steele	171457	367	52	61	59.2	44.9	44.1	15.3	Do.
Colorado:									
Escalante Hills	148145	382	65	67	59.4	44.8	45.8	16.1	Moderately worn.
Grand Junction	54111	361	55	64	59.9	44.7	44.0	15.6	Considerably worn.
C. parvidens.									
Utah:									
Buckskin Valley	158985	337	57	60	54.5	40.7	42.2	14.9	Moderately worn.
Do	158992	326	57	59	54.1	40.7	41.8	14.8	Do.
Do	158993	305	52	57	53.0	38.3	40.3	14.8	Little worn.
Sevier National Forest	206323	335	31	55	57.9	43.9	42.2	15.0	Moderately worn.
Do	206337	354	49	60	57.6	43.2	42.9	15.2	Do.
C. gunnisoni gunnisoni.									
Colorado:									
Cochetopa Pass	35845	343	52	53	53.8	40.7	41.1	14.7	Moderately worn.
Do	35849	323	41	52	52.4	41.5	40.9	14.0	Considerably worn.
Do	35854	330	45	56	54.9	42.6	42.5	14.7	Moderately worn.
Do	35855	332	45	56	54.9	42.5	42.5	14.6	Do.
Do	35856	331	52	55	54.4	42.7	41.4	15.0	Considerably worn.
New Mexico: La Jara Lake	134908	328	68	54	53.4	41.3	40.0	14.8	Do.
C. gunnisoni zuniensis.									
New Mexico:									
Thoreau	160752	340	60	57	53.8	41.1	41.6	14.5	Considerably worn.
Wingate	[1] 137555	363	53	60	57.9	43.8	43.0	15.6	Much worn.
Acoma	148290	360	60	62	55.9	43.5	44.5	15.4	Moderately worn.
Magdalena	167574	350	60	61	54.7	43.7	42.0	15.0	Much worn.
Ojo Caliente	167021	350	49	60	57.6	43.0	42.2	15.1	Considerably worn.
Arizona:									
Springerville	24653	355	63	60	55.2	43.4	42.8	14.7	Moderately worn.
Do	24654	357	70	60	55.0	43.2	41.7	14.6	Do.
Flagstaff	201638	356	64	59	56.4	44.0	42.7	14.3	Much worn.
Kendrick Park	202942	373	68	60	57.8	44.5	44.2	14.8	Do.
Little Spring	202556	363	54	58	55.9	45.0	42.9	14.4	Considerably worn.

[1] Type.

Averages of adult male specimens of Cynomys.

Species and locality.	Number of specimens averaged.	Skin.			Skull.					
		Total length.	Tail vertebræ.	Hind foot.	Condylobasal length.	Zygomatic breadth.	Mastoid breadth.	Nasals.	Mandible.	Maxillary tooth row.
C. ludovicianus ludovicianus.										
Montana	6	383	84	61	60.4	45.1	28.0	22.8	45.8	16.4
North Dakota	1	405	96	64	61.4	45.5	28.1	23.1	45.9	16.9
South Dakota	13	388	86	62	59.8	45.0	28.5	23.8	45.9	16.6
Wyoming	4	393	86	63	60.7	45.3	28.3	24.0	46.2	16.8
Nebraska	3	397	86	62	60.9	45.8	28.9	23.4	46.3	16.8
Colorado	4	364	82	62	58.9	44.1	27.8	23.1	45.1	16.9
Kansas	10	380	88	62	59.7	44.7	27.8	23.1	45.5	16.5
Oklahoma	2	376	110	63	60.6	44.5	28.3	23.5	46.6	17.2
Texas	7	392	88	62	61.5	45.5	29.0	24.5	46.9	16.7
C. ludovicianus arizonensis.										
Texas	7	395	88	64	60.3	44.7	27.7	24.3	46.5	16.6
New Mexico	18	381	84	62	60.1	44.3	28.0	23.8	45.0	16.2
Arizona	19	388	89	62	60.0	44.0	27.3	24.0	45.2	16.2
Chihuahua	1	400	80	65	62.9	45.0	29.1	23.5	46.0	16.6
C. mexicanus.										
Coahuila	8	416	102	63	59.3	44.6	28.6	23.0	43.8	15.9
C. leucurus.										
Wyoming	13	358	57	62	58.7	43.8	29.0	22.0	43.1	15.7
Colorado	6	368	56	63	60.0	44.6	29.8	22.6	45.0	15.6
C. parvidens.										
Utah	8	338	43	59	55.9	42.2	28.6	21.8	42.3	15.0
C. gunnisoni gunnisoni.										
Colorado	12	340	53	56	54.8	42.5	27.0	20.5	41.9	14.5
New Mexico	1	328	68	54	53.4	41.3	25.8	21.5	40.0	14.8
C. gunnisoni zuniensis.										
New Mexico and eastern Arizona	17	344	60	58	55.0	41.9	27.4	21.5	42.3	14.8
Arizona: San Francisco Mountain	9	355	62	60	55.8	43.5	27.4	21.9	42.7	14.5

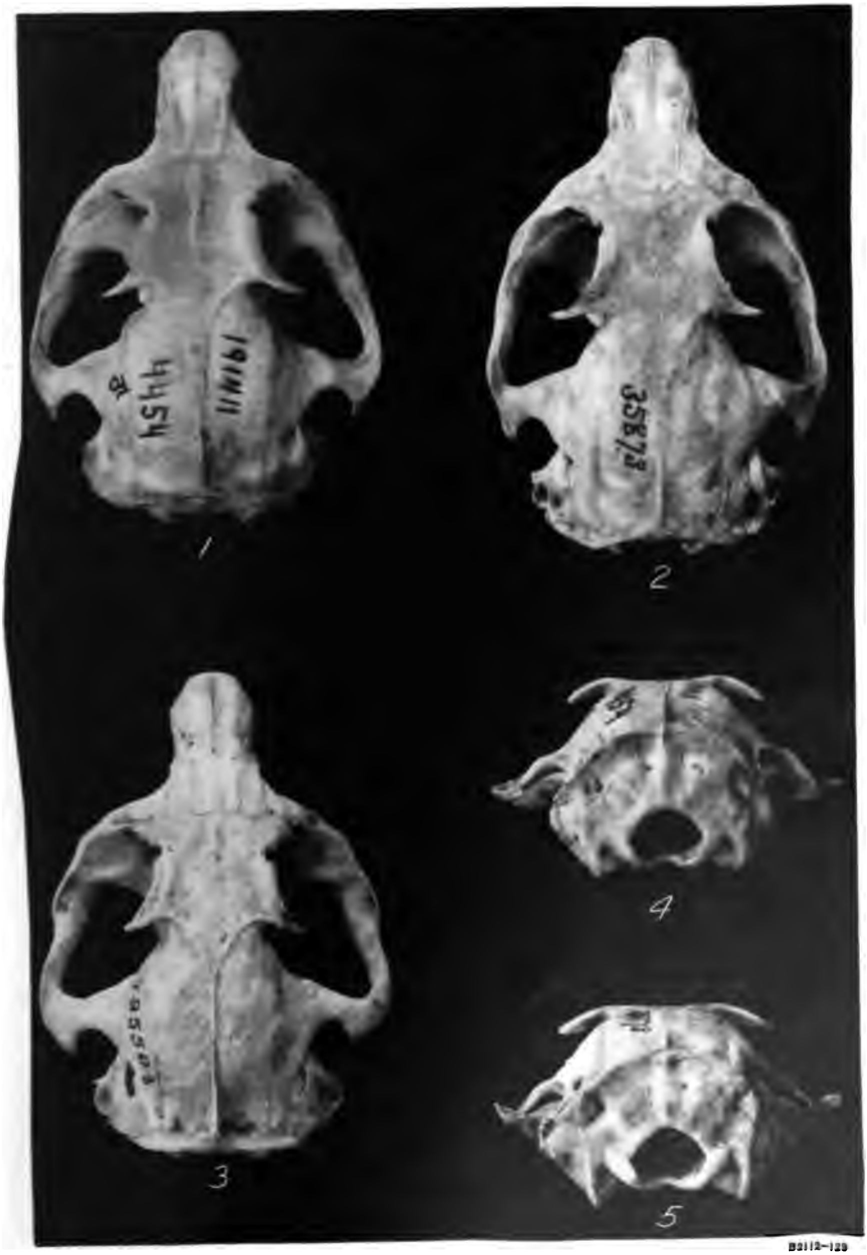
PLATE I.

(About natural size.)

FIGS. 1 and 4. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Glendive, Montana. (No. 191411, U. S. Nat. Mus.)

FIGS. 2 and 5. *Cynomys ludovicianus arizonensis* Mearns. ♂ ad. San Pedro River, Arizona. (No. 35873, U. S. Nat. Mus.)

FIG. 3. *Cynomys mexicanus* Merriam. ♂ ad. La Ventura, Coahuila, Mexico. (No. 79550, U. S. Nat. Mus., Biological Survey collection.)



B2112-123

SKULLS OF CYNOMYS.

1, 4. C. l. ludovicianus.
2, 5. C. l. arizonensis.
3. C. mexicanus.

PLATE II.

(About natural size.)

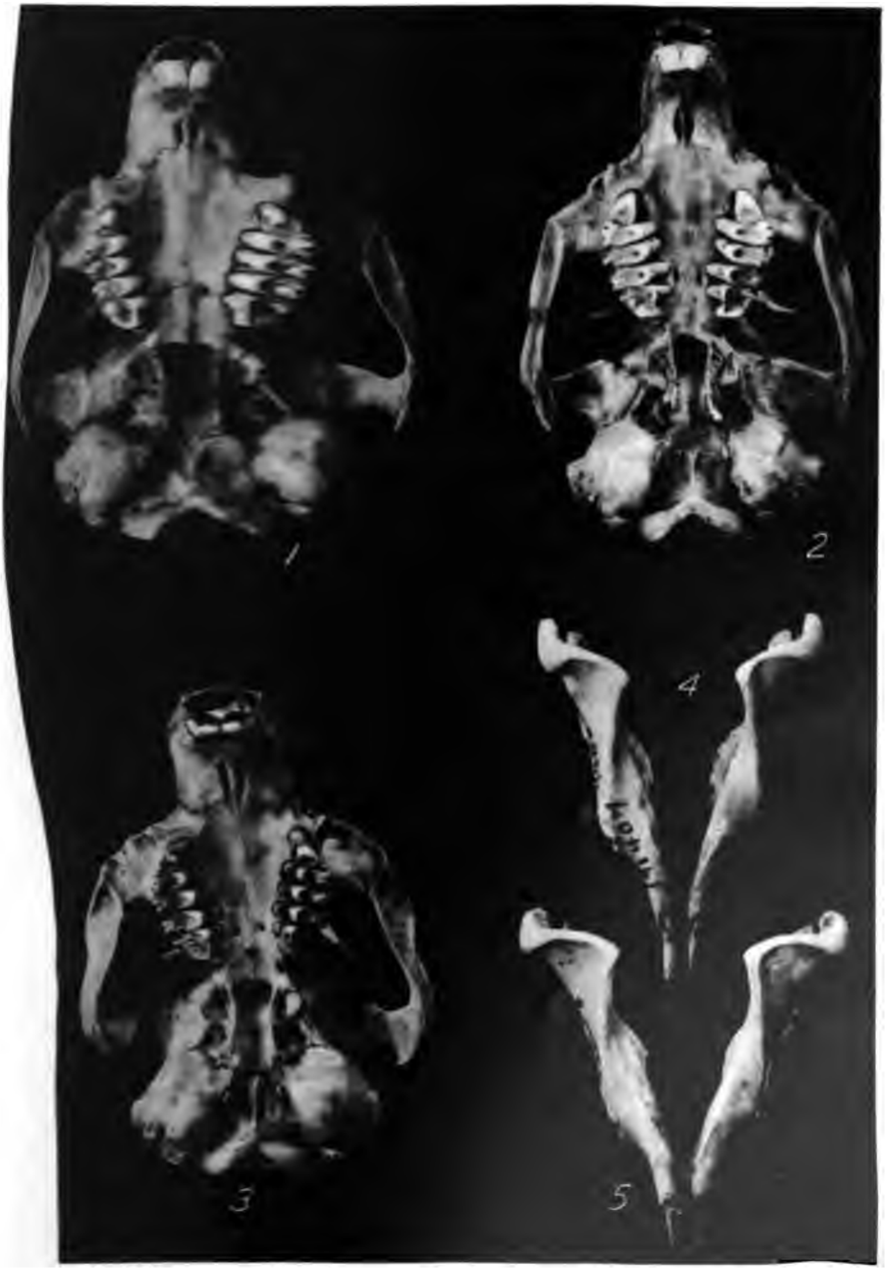
Fig. 1. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Glendive, Montana. (No. 191411, U. S. Nat. Mus.)

Fig. 2. *Cynomys ludovicianus arizonensis* Mearns. ♂ ad. San Pedro River, Arizona. (No. 35873, U. S. Nat. Mus.)

Fig. 3. *Cynomys mexicanus* Merriam. ♂ ad. La Ventura, Coahuila, Mexico. (No. 79550, U. S. Nat. Mus., Biological Survey collection.)

Fig. 4. *Cynomys ludovicianus ludovicianus* (Ord). ♀ ad. Glendive, Montana. (No. 191407, U. S. Nat. Mus.)

Fig. 5. *Cynomys mexicanus* Merriam. ♀ ad. La Ventura, Coahuila, Mexico. (No. 79554, U. S. Nat. Mus., Biological Survey collection.)



B2113—129

SKULLS OF CYNOMYS.

1, 4. C. l. ludovicianus.
2. C. l. arizonensis.
3, 5. C. mexicanus.

PLATE IV.

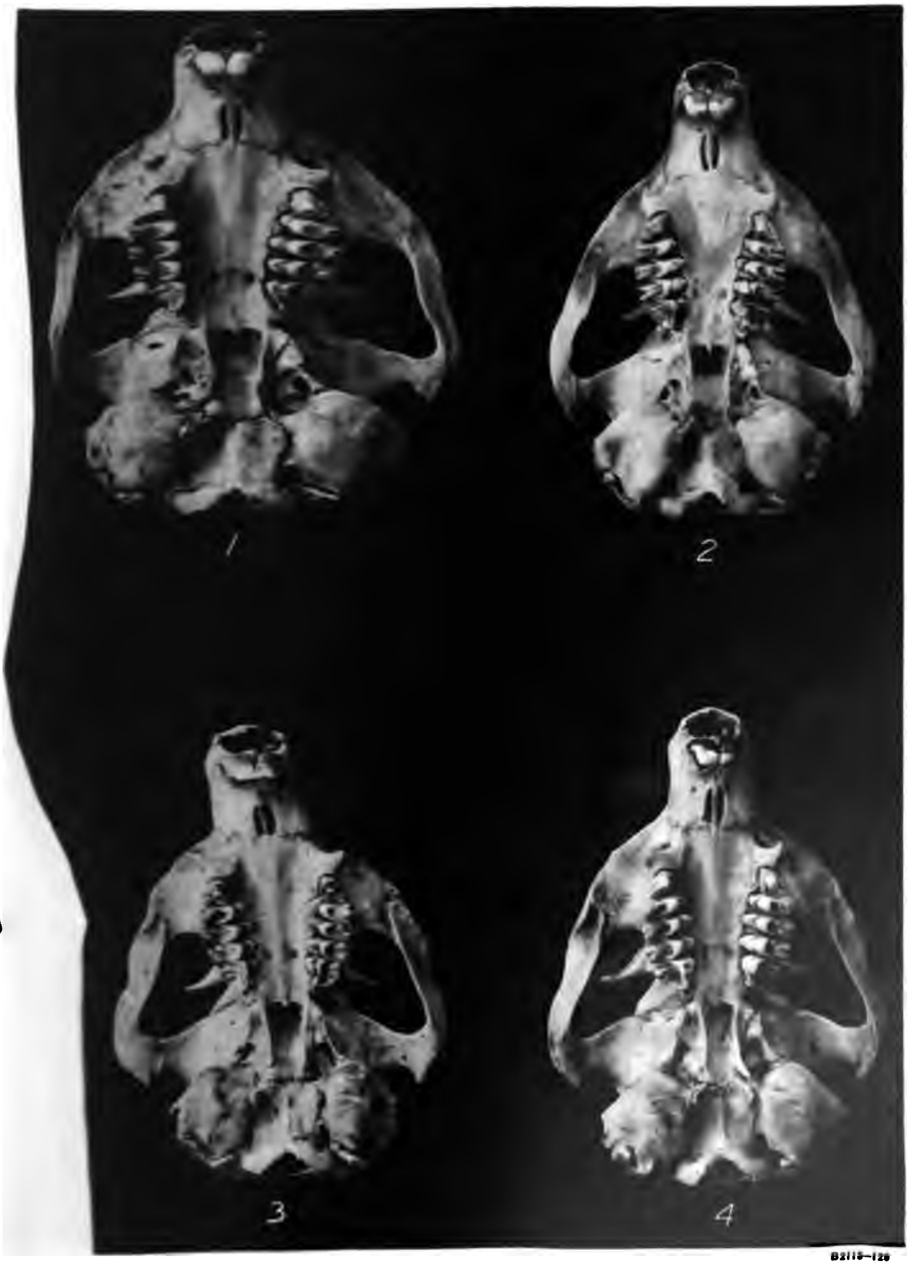
(About natural size.)

Fig. 1. *Cynomys leucurus* Merriam. ♂ ad. Cumberland, Wyoming. (No. 179515, U. S. Nat. Mus., Biological Survey collection.)

Fig. 2. *Cynomys parvidens* Allen. ♀ ad. Buckskin Valley, Utah. (No. 158994, U. S. Nat. Mus., Biological Survey collection.)

Fig. 3. *Cynomys gunnisoni gunnisoni* (Baird). ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)

Fig. 4. *Cynomys gunnisoni zuniensis* Hollister. ♂ ad. Wingate, New Mexico. (Type, No. 137555, U. S. Nat. Mus., Biological Survey collection.)



B2115—126

SKULLS OF CYNOMYS.

1. C. leucurus.
2. C. parvidens.
3. C. g. gunnisoni.
4. C. g. zuniensis.

PLATE V.

(About natural size.)

Fig 1. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Glendive, Montana. (No. 191411, U. S. Nat. Mus., Merriam collection, original number, 4454.)

Fig. 2. *Cynomys ludovicianus arizonensis* Mearns. ♂ ad. San Pedro River, Arizona. (No. 35873, U. S. Nat. Mus.)

Fig. 3. *Cynomys mexicanus* Merriam. ♂ ad. La Ventura, Coahuila, Mexico. No. 79550, U. S. Nat. Mus., Biological Survey collection.)

Fig. 4. *Cynomys parvidens* Allen. ♀ ad. Buckskin Valley, Utah. (No. 158994, U. S. Nat. Mus., Biological Survey collection.)

Fig. 5. *Cynomys gunnisoni gunnisoni* (Baird). ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)

Fig. 6. *Cynomys gunnisoni zuniensis* Hollister. ♂ ad. Wingate, New Mexico. (Type, No. 137555, U. S. Nat. Mus., Biological Suvery collection.)

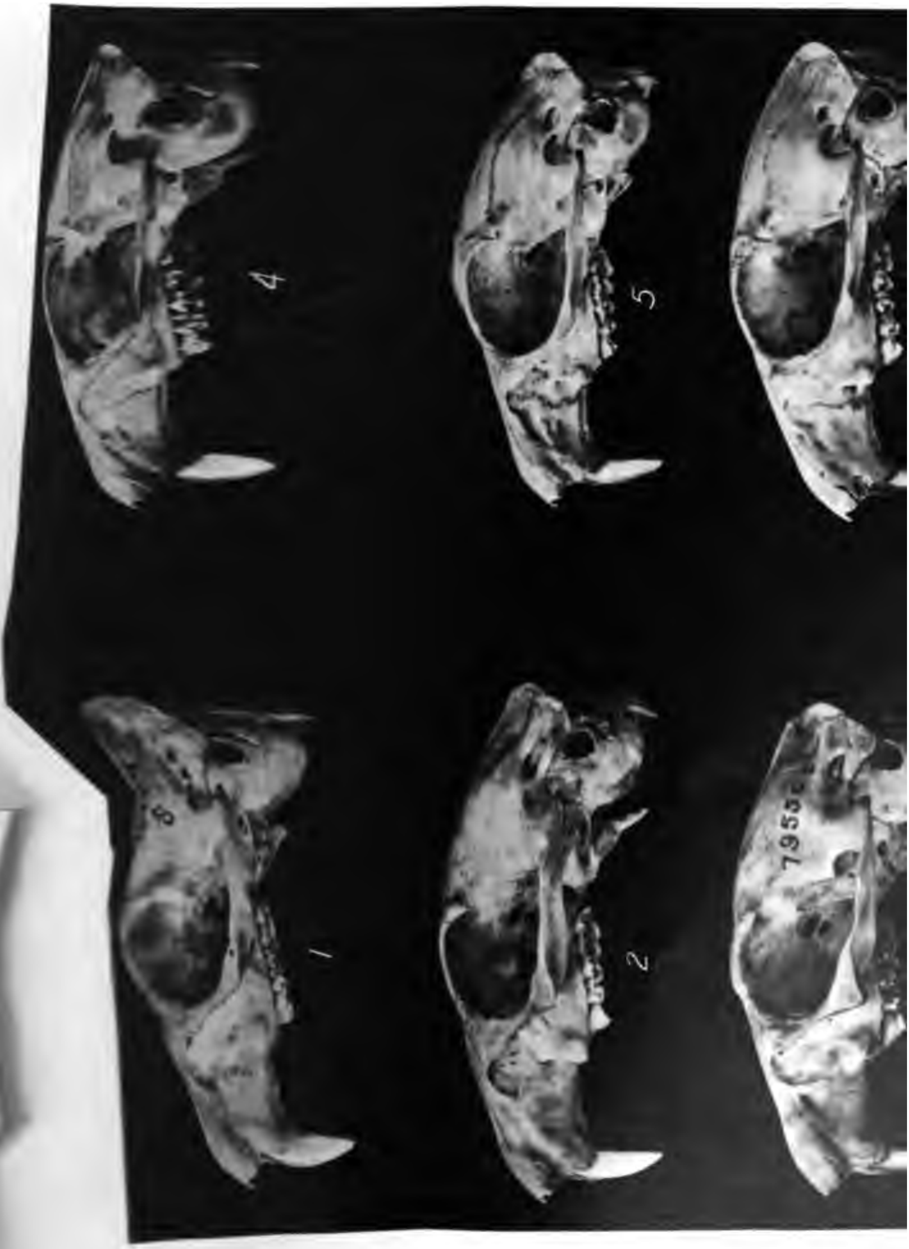

4
5
8
1
2
7955

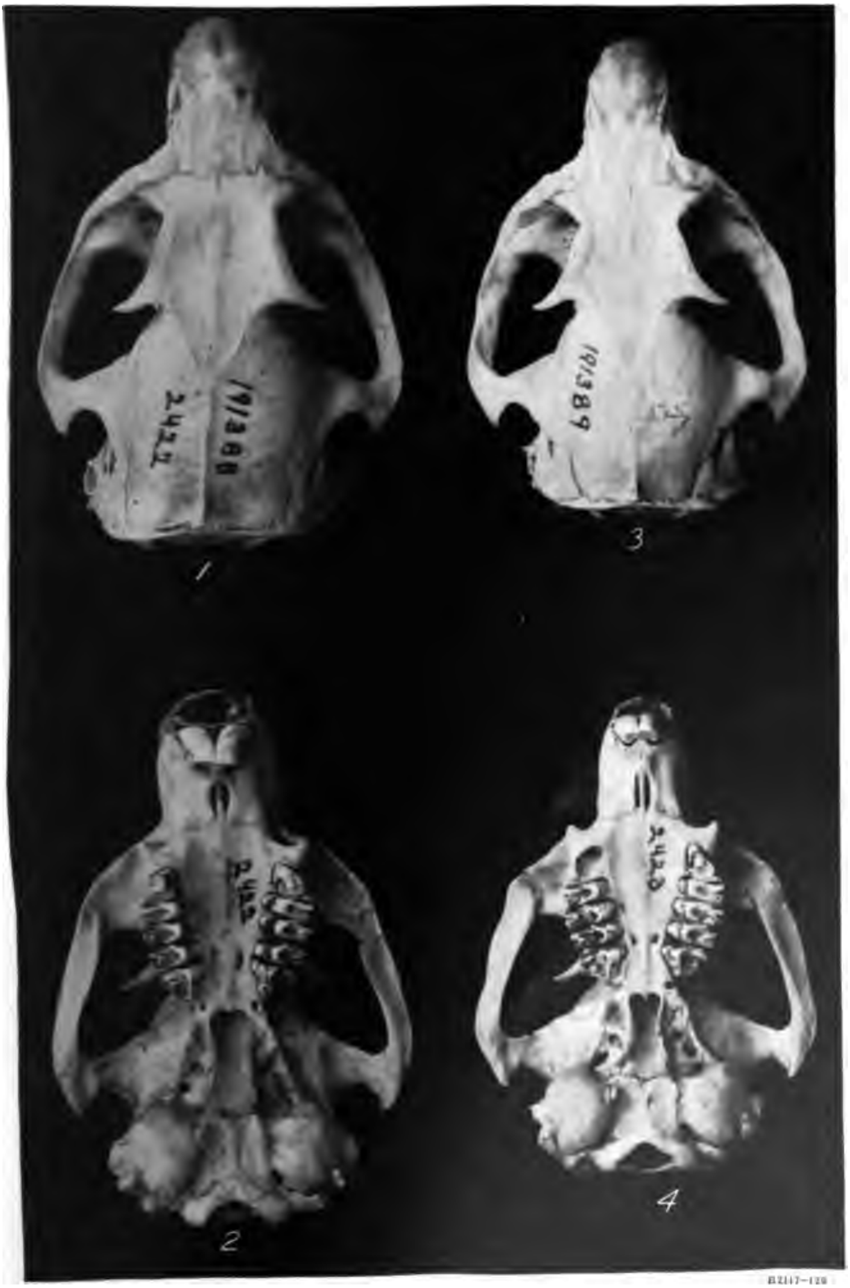
Plate VI.

(About natural size.)

Figs. 1 and 2. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Mason, Texas. (No. 191388, U. S. Nat. Mus.)

Figs. 3 and 4. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Mason, Texas. (No. 191389, U. S. Nat. Mus.)

Selected skulls of same sex and age from one locality; to show the great individual variation frequently noted in skulls of *Cynomys*.



B2117-120

SKULLS OF CYNOMYS LUDOVICIANUS LUDOVICIANUS.

PLATE VII.

(About natural size.)

Fig. 1. *Cynomys ludovicianus ludovicianus* (Ord), left mandibular ramus. ♀ ad. Glendive, Montana. (No. 191407, U. S. Nat. Mus.)

Fig. 2. *Cynomys mexicanus* Merriam, left mandibular ramus. ♀ ad. La Ventura, Coahuila, Mexico. (No. 79554, U. S. Nat. Mus., Biological Survey collection.)

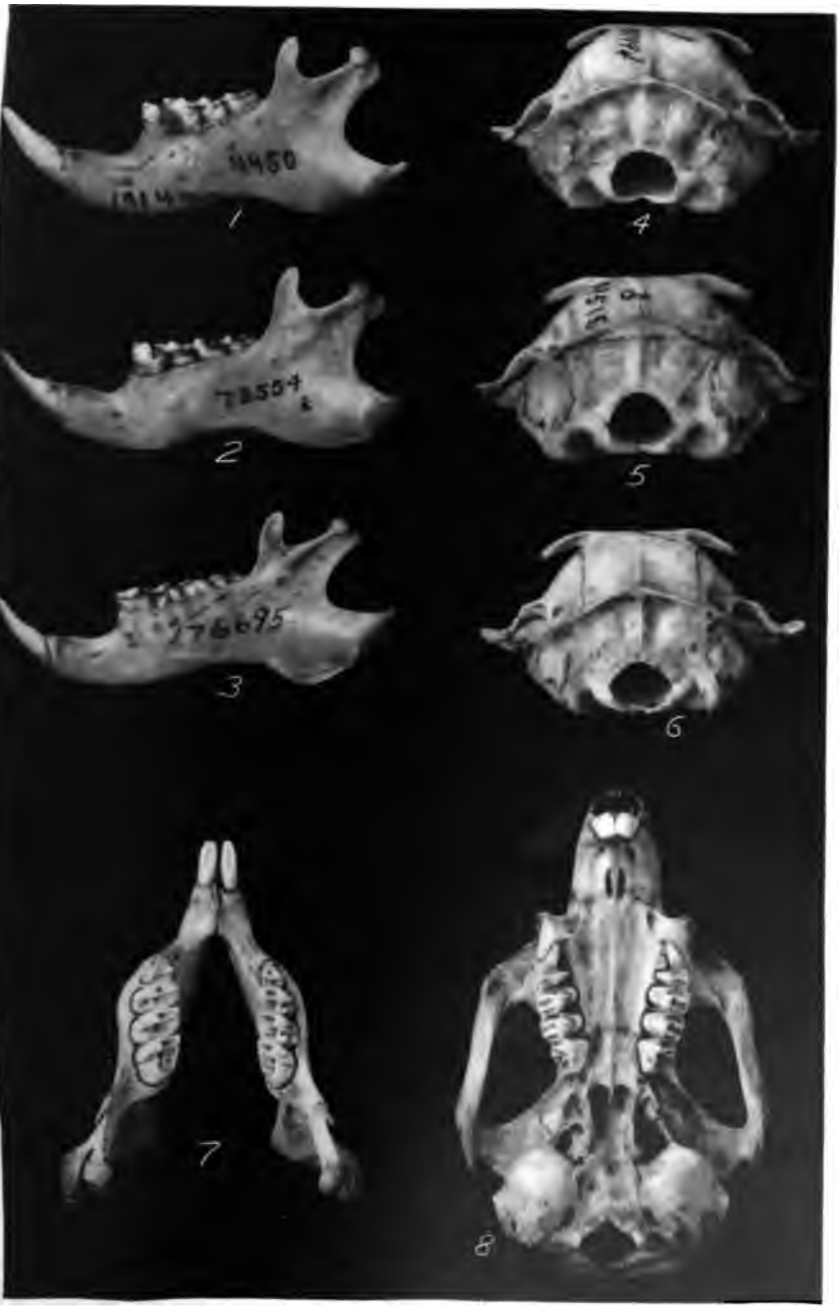
Fig. 3. *Cynomys gunnisoni gunnisoni* (Baird), left mandibular ramus. ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)

Fig. 4. *Cynomys parvidens* Allen. ♀ ad. Buckskin Valley, Utah. (No. 158994, U. S. Nat. Mus., Biological Survey collection.)

Fig. 5. *Cynomys leucurus* Merriam. ♂ ad. Cumberland, Wyoming. (No. 179515, U. S. Nat. Mus., Biological Survey collection.)

Fig. 6. *Cynomys gunnisoni gunnisoni* (Baird). ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)

Figs. 7 and 8. *Cynomys ludovicianus ludovicianus* (Ord). ♀ juv., showing milk premolars and unworn crowns of molars. Ishawooa, Wyoming. (No. 169674, U. S. Nat. Mus., Biological Survey collection.)



B2118—129

SKULLS OF CYNOMYS.

1, 7, 8. C. l. ludovicianus.
2. C. mexicanus.
3, 6. C. g. gunnisoni.
4. C. parvidens.
5. C. leucurus.

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[New names in **bold-face type**; synonyms in *italics*.]

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U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
E. W. NELSON, *Chief*

NORTH AMERICAN FAUNA
No. 41

[Actual date of publication, February 9, 1918]

REVIEW OF THE GRIZZLY AND BIG BROWN BEARS OF NORTH AMERICA
(GENUS URSUS)
WITH DESCRIPTION OF A NEW GENUS, VETULARCTOS

BY

C. HART MERRIAM

CONSULTING BIOLOGIST, BIOLOGICAL SURVEY
RESEARCH ASSOCIATE, SMITHSONIAN INSTITUTION

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

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(Continued on page 3 of cover.)

WILD GRIZZLY IN NORTHWESTERN WYOMING.

Photograph made and used by permission of Frederick K. Vreeland.

U. S. DEPARTMENT OF AGRICULTURE

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1918

LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., July 18, 1917.

Sir: I have the honor to transmit for publication as North American Fauna No. 41 a review of the grizzly and big brown bears of North America, by Dr. C. Hart Merriam, consulting biologist and former chief of the Biological Survey and research associate of the Smithsonian Institution. This review was prepared and originally submitted in September, 1916, but before composition was begun it was recalled from the printer in order that additional information, developed by the discovery of new material, might be included. The work is based largely upon material in the collection of the Biological Survey. Up to 20 years ago only 8 species of grizzly and big brown bears were known, but since then, largely through the investigations of Dr. Merriam, the number of recognizable forms has increased to 86. Additional study and material may solve certain points now in doubt, but it is not deemed advisable to delay further the publication of our present state of knowledge of this group of America's historic big game animals, now vanished from great stretches of their former domain. This review will be of material assistance to students and others interested in our native wild life, past and present.

Respectfully,

E. W. Nelson,
Chief, Biological Survey.

Hon. David F. Houston,
Secretary of Agriculture.

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III. Skull of *Ursus middendorffi*, old ♂, from Chiniak Point, Kodiak Island, Alaska. No. 96509.
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XVI. Skull of *Ursus arizonæ*, adult ♂, from Escudilla Mountains, Apache County, Arizona. No. 177332 (type).

[The plates of skulls, owing to restriction of space, are limited to the side view, and consequently in some cases are misleading. Skulls having similar profiles often differ surprisingly when viewed from above or below, as would be seen at a glance were it practicable to give two views.]

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REVIEW OF THE GRIZZLY AND BIG BROWN BEARS OF NORTH AMERICA

(GENUS URSUS)

WITH DESCRIPTION OF A NEW GENUS, VETULARCTOS.

By C. Hart Merriam.

INTRODUCTION.

When Audubon and Bachman published their great work on the Mammals of North America (1846–1854), and in fact up to the year 1857, it was commonly believed by naturalists as well as by hunters and the public generally that there was only a single species of grizzly bear—the one described by Lewis and Clark in 1804–5, and named *Ursus horribilis* by Ord in 1815. Baird, in 1857, described another species, from Coppermines, New Mexico, which he named *Ursus horriæus*.

Nearly 40 years later, in my "Preliminary Synopsis of the American Bears,"[1] eight grizzlies and big brown bears were recognized, of which five were described as new. It was not then suspected that the number remaining to be discovered was anything like so great as has since proved to be the case. The steady influx of specimens resulting from the labors of the Biological Survey, supplemented by the personal efforts of a number of hunter-naturalists, brought to light many surprises, most of which have been published; and beginning in the spring of 1910, a fund placed at my disposal made it possible to offer hunters and trappers sufficient inducement to tempt them to exert themselves in securing needed specimens. As a result, the national collection of bears has steadily grown until, in number of species represented, in completeness of series, and in number of type specimens, it now far excels all other collections in the world together. Nevertheless there are many gaps in the series.

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[1] Proc. Biol. Soc. Washington, X, pp. 65–83, April 13, 1896.

Knowledge of the big bears is by no means complete and many years must pass before the last word on the subject will be written. Many bears now roaming the wilds will have to be killed and their skulls and skins sent to museums before their characters and variations will be fully understood and before it will be possible to construct accurate maps of their ranges. Persons having the means and ambition to hunt big game may be assured that bears are still common in many parts of British Columbia, Yukon Territory, and Alaska, and that much additional material is absolutely required to settle questions still in doubt.

Among the localities from which specimens are greatly needed may be mentioned Lynn Canal and Lituya Bay, Alaska, and in fact the entire coast strip between Cross Sound and Yakutat Bay; the Cook Inlet and Susitna regions; the mountains between the Yukon and Tanana; the Endicott Range and other mountains between the Yukon and the Arctic coast all the way from Seward Peninsula to the Alaska-Yukon boundary; the Rocky Mountains of Canada, from British Columbia northward, including the sources of the Pelly, Macmillan, Stewart, and Porcupine Rivers; the Mackenzie River and Great Bear Lake region; the southwest corner of Yukon Territory; the western part of Alberta; and the interior of British Columbia. In the United States, skulls of adult males are much needed from all localities inhabited by grizzly bears, particularly in Colorado, Idaho, Montana, and Wyoming—including the Glacier and other National Park regions.

What is most needed to-day in this line is a series of adults collected by absolutely trustworthy persons and labeled on the spot for locality and sex. Many specimens in museums are not labeled for sex; others have the sex wrongly marked; and many either lack localities or the localities given are open to serious doubt. A specimen is of little value unless one can pin his faith on the label.

Some writers have advanced the view that the various species of bears freely interbreed. Let those so minded ask themselves the question, If promiscuous interbreeding were to take place, what would become of the species? From the nature of the case, the stability of species depends on the rarity of crossings with other species, for if interbreeding were to take place frequently the species so interbreeding would of course cease to exist, having merged into a common hybrid. Hybrids now and then occur, particularly in zoological gardens, but among wild animals in their native haunts they are exceedingly rare.

The number of species here given will appear to many as preposterous. To all such I extend a cordial invitation to visit the National

Museum and see for themselves what the bear skulls show. Recognition of species is a matter of interpretation. If the material is adequate there can be little room for difference of opinion; if inadequate, many important points must remain in doubt. It is not the business of the naturalist either to create or to suppress species, but to endeavor to ascertain how many Nature has established, and having discovered this, to point out their characters and learn as much as possible about them.

One of the unlooked-for results of the critical study of the American bears is the discovery that the big bears, like mice and other small mammals, split up into a large number of forms whose ranges in some cases overlap so that three or more species may be found in the same region.

Another surprising result is the discovery that Admiralty Island in Southeastern Alaska appears to be inhabited by no less than five distinct species, each of which is obviously related to and representative of an adjacent mainland species. The recognition of this very remarkable state of affairs makes it possible to understand what before had seemed a most anomalous condition, namely, the extraordinary diversity or variability of the skulls and teeth of the island bears. It was not until material essential for the determination of the mainland forms had been collected that it was possible to recognize and define the island forms.

The varying degrees of divergence of the island bears furnish an interesting index to the relative time when each obtained a foothold on the island. In this connection it is well to remember that the breadth of the strait separating Admiralty Island from the mainland at its narrowest point does not exceed 5 miles.

The mainland big bears with their representatives on Admiralty Island here provisionally recognized are:

MAINLAND SPECIES.	ADMIRALTY ISLAND SPECIES.
Ursus dalli	*Ursus shirasi.*
Ursus stikeenensis	*Ursus mirabilis.*
Ursus tahltanicus	*Ursus insularis.*
Ursus kwakiutl	*Ursus neglectus.*
Ursus caurinus	*Ursus eulophus.*

GEOGRAPHIC DISTRIBUTION.

In early days grizzly bears were common in most parts of western North America, their range being nearly continuous from northern Mexico northward through the Western States and western Canada to northern Alaska; but now within the United States several of the species are extinct, and those still living are confined in the main to remote or inaccessible mountain ranges, where two or more species not infrequently occur together. In many cases the original distribution areas overlapped, as they do to-day in parts of British Columbia, Yukon, and Alaska; in other cases, owing to the settlement of the country, species inhabiting easily accessible areas were either exterminated or forced into mountains where they now occupy the same ground with other species, so that it is impossible to ascertain what the original distribution was. As a rule, in cases where two or more species inhabit the same area, the species occurring together belong to different superspecific groups. Thus in the Yellowstone Park and Stikine River regions representatives of the *horribilis*, *absarokus*, *tahltanicus*, and *chelan* groups occur, so far as known, in the same localities.

SEXUAL DIFFERENCES.

In most species of bears the males are much larger than the females. In some the disparity in size is very remarkable, as in *middendorffi* of Kodiak Island and *magister* of southern California. In a few cases the difference is slight, as in *kidderi* of Alaska Peninsula.

AGE DIFFERENCES.

Bear skulls undergo a series of changes from early life to old age, and in most species do not attain their mature form until seven or more years of age. In species having the frontal shield highly elevated, as in *middendorffi*, *kluane*, *stikeenensis*, and *mirabilis*, the frontals reach their maximum of arching or bulging in early adult life (about the sixth year), after which they gradually become flatter.

MATERIAL EXAMINED.

It is a pleasure to express appreciation of the invaluable assistance rendered by the loan or presentation of skins and skulls of grizzly and brown bears utilized in the preparation of the accompanying descriptions. To Charles Sheldon, G. Frederick Norton, and the late Charles R. Cross, jr., and to J. H. Kidder, Robert P. Blake, Waldo Emerson Forbes, George Mixter, Samuel Mixter, Dr. William Jason Mixter, Charles S. King, and Homer E. Sargent, special thanks are due for their generosity in placing at my disposal the valuable specimens and notes obtained on their private hunting trips. Most of these specimens have been presented to the national collections. And to Miss Annie M. Alexander, of Oakland, California, special acknowledgment should be made for the loan of her collection of

Alaska bears, now in the Museum of Vertebrate Zoology of the University of California, and second only to that of the Biological Survey and National Museum.[1]

In conclusion it is only proper to state that the material on which the present publication is based could not have been brought together during my lifetime, nor the results prepared for publication, but for the generous assistance of Mrs. E. H. Harriman in establishing under the Smithsonian Institution a special research fund for my scientific work.

TECHNICAL TERMS.

In describing the skulls of bears a few terms are used in a special sense which it is desirable to understand.

The *frontal shield* is that part of the top of the skull extending from the base of the rostrum backward to the meeting point of the temporal impressions. It is elevated above the surrounding parts and is sharply defined. Its posterior point, confined between the temporal impressions, is longer in female than in male skulls, and up to a certain limit becomes shorter with age.

The *postorbital processes* stand out from the sides of the frontal shield, limiting the orbits posteriorly.

The term *sulcate* is applied to skulls having a longitudinal median depression or groove in the frontal shield, usually shallow and rather broad and without definite lateral limits.

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[1] Others who have helped by the presentation or loan of material are: C. E. Aiken, Dr. J. A. Allen, Dr. R. M. Anderson, Edward F. Ball, Dr. Arthur H. Bannon, Dr. William Bebb, H. C. Beggs, Mrs. C. C. Beggs, John P. Bird, W. C. Bradbury, J. Stanley-Brown, Fred K. Burnham, Mr. and Mrs. E. S. Cameron, Dr. Frank M. Chapman, R. H. Chapman, Elton Clark, James L. Clark, Charles B. Cory, Prof. Charles R. Cross, Heyward Cutting, Frank S. Daggett, E. W. Deming, Howard Eaton, Charles Farwell Edson, Lincoln Ellsworth, Lieut. G. T. Emmons, J. D. Figgins, J. Stanley Foster, Charles A. Gianini, Dr. J. B. Girard, Dr. Joseph Grinnell, Samuel Henshaw, Charles J. Hittell, Dr. W. J. Holland, Dr. R. Houston, James T. Jardine, Remington Kellogg, Francis Kermode, Charles S. King, Paul Kleineidam, Prof. S. H. Knight, Frederick Lambart, Edward H. Litchfield, Col. J. A. McGuire, John Murgatroyd, Prof. C. C. Nutting, Wilfred H. Osgood, John M. Phillips, the late W. Hallett Phillips, the late Warburton Pike, Wilson Potter, George D. Pratt, Dr. E. P. Richardson, Powhatan Robinson, Archibald Rogers, Carl Rungius, Homer E. Sargent, Prof. W. B. Scott, George Shiras 3d, George Shiras 4th, Dr. H. A. Sifton, Henry A. Stewart, Dr. Walter T. Swingle, P. A. Taverner, Prof. S. D. Thacher, Dr. Charles H. Townsend, Frederick K. Vreeland, E. R. Warren, A. Bryan Williams, and W. W. Wood.

Fullest acknowledgments are due the following institutions for their courtesy in loaning specimens: American Museum of Natural History, New York; Carnegie Museum, Pittsburgh; Colorado Museum of Natural History, Denver; Field Museum of Natural History, Chicago; Museum of Comparative Zoology, Cambridge; Museum of History, Science, and Art, Los Angeles; Museum of Vertebrate Zoology, University of California; Peabody Museum of Salem; Peabody Museum of Yale University; Provincial Museum, Victoria, British Columbia; U. S. National Museum, Washington; Victoria Memorial Museum, Ottawa; Zoological Society of Philadelphia; and the Museums of the Universities of Iowa, Kansas, Nebraska, and Wyoming.

For the frontispiece, showing a wild grizzly in a pine forest near Yellowstone Park, western Wyoming, thanks are due Frederick K. Vreeland, who was so fortunate as to take the photograph.

The term *dished* means that the nasal or fronto-nasal region is depressed, producing a change of angle from the plane of the anterior part of the nasals to the plane (or slope) of the frontal shield. Some skulls are strongly dished, some are flat, while some have the fronto-nasal region elevated and compressed, giving a very different outline from that of the normally dished skull.

The term *braincase* is loosely applied to the whole upper rounded part of the skull between the occiput and postorbital processes, but not including the wedge-shape posterior part of the frontal shield. Used in this way, it covers the parietal bones and posterior part of the frontals on each side of the temporal ridges, including not only the actual bony case inclosing the brain, but also its anterior continuation (the sinus case).

The term *sinus case* is applied more definitely to the smoothly rounded part of the frontals below the shield and in direct continuation of the braincase—the outer shell covering the large sinuses or air cells lying between the nasal chamber and the brain. It is not always discriminated from the braincase.

The term *bellied* is applied to the posterior part of the inferior border of the ramus of the underjaw to indicate a swelling or thickening common in many species.

The term *subangular border* is applied to the posterior part of the inferior border of the underjaw, immediately anterior to the angular process, and usually set off from the rest of the ramus by a step or small tubercle.

The term *keeled* is applied to a not uncommon condition of the upper part of the sinus case, in which the top or arch is compressed, rising rather narrowly into the anterior part of the sagittal crest and posterior part of the frontal shield. The condition is marked in *Ursus eulophus* and occurs in several other species. In most species, however, this part of the braincase is rather broadly rounded, the sagittal crest rising abruptly from the median line.

Measurements are always in millimeters unless otherwise specified.

The museum number of the skull, unless otherwise stated, is understood to be that of the United States National Museum.

CLASSIFICATION OF GRIZZLY AND BIG BROWN BEARS.

The differences formerly supposed to exist between the grizzlies and the big brown bears appear, in the light of the material now available, to distinguish certain groups of species from certain other groups, rather than the grizzlies collectively from the big brown bears collectively. In other words, the differences between the grizzlies on the one hand and the big brown bears on the other are neither so great nor so constant as at one time believed. And there are species which in the present state of knowledge can not be positively referred to either group. In fact, it seems at least possible that certain species which appear to belong with the grizzlies are closely related to certain other species which clearly belong with the big brown bears. The typical brown bears differ from the typical grizzlies in peculiarities of color, claws, skull, and teeth. The color of the former is more uniform, with less of the surface grizzling due to admixture of pale-tipped hairs; the claws are shorter, more curved, darker, and scurfy instead of smooth; the skull is more massive; the fourth lower premolar is conical, lacking the sulcate heel of the true grizzlies. But these are average differences, not one of which holds true throughout the group. Most of the specimens in museums consist of skulls only, unaccompanied by skins or claws, leaving a doubt as to the external characters; and in old bears the important fourth lower premolar is likely to be so worn that its original form can not be made out. And, worst of all, some of the grizzlies lack the distinctive type of premolar, leaving only the skull as a guide to their affinities. The present classification, therefore, must be regarded as tentative and subject to revision.

RELATIVE VALUES OF CRANIAL AND DENTAL CHARACTERS.

In my judgment cranial characters among the bears of the genus *Ursus* are more permanent and of more significance from the standpoint of classification than minor tooth characters. The teeth are strongly modified by food and consequently in some cases present marked variations in the same group. Thus the skull of adult male *chelidonias* from the coast of southern British Columbia is almost indistinguishable from that of *imperator* from the Yellowstone Park, a member of the *horribilis* group; but *imperator* has very large molars, nearly as big as those of *horribilis* and *bairdi*, while *chelidonias*, being a fish eater, has such small molars that were it not for the skull no one would think of placing it in the *horribilis* group.

Cranial and dental characters among the big bears are very subtle. As a rule comparison of any two skulls of essentially the same size brings to light so many resemblances that one is likely to infer a far closer relationship than actually exists. This is because the big bears of the genus *Ursus* are such a closely interrelated group that the resemblances far outnumber the differences. Hence the greatest caution is necessary to avoid misleading conclusions.

The present paper is merely a review of the existing state of knowledge of the grizzlies and big brown bears of America and does not include either the polar or the black bears. It is not intended as a monographic revision, but aims to supply a list of the species, together with descriptions and comparisons of adult skulls, chiefly males. Little is said of external characters, for the reason that little is known, only a few skins with claws being available for study.

List of Species and Subspecies of Grizzly and Big Brown Bears, with Type Localities.[1]

(Classification provisional.)

Horribilis group (pp. 17–34):	
Ursus horribilis horribilis Ord	Missouri River, northeastern Montana.
horribilis bairdi Merriam	Blue River, Summit County, Colorado.
horribilis imperator Merriam	Yellowstone National Park, Wyoming.
chelidonias nobis	Jervis Inlet, British Columbia.
atnarko nobis	Atnarko River, British Columbia.
kwakiutl Merriam	Jervis Inlet, British Columbia.
nortoni Merriam	Southeastern side Yakutat Bay, Alaska.
warburtoni Merriam	Atnarko River, British Columbia.
neglectus Merriam	Near Hawk Inlet, Admiralty Island, Southeastern Alaska.
californicus Merriam	Monterey, California.
tularensis Merriam	Fort Tejon, California.
colusus Merriam	Sacramento Valley, California.
dusorgus nobis [2]	Jack Pine River, Alberta-British Columbia boundary.
Planiceps group (pp. 34–53):	
Ursus nelsoni Merriam	Colonia Garcia, Chihuahua, Mexico.
texensis texensis Merriam	Davis Mountains, Texas.
texensis navaho Merriam	Navajo country near Fort Defiance, Arizona. (Probably Chuska Mountains.)
planiceps nobis	Colorado (exact locality uncertain).
macrodon nobis	Twin Lakes, Colorado.
mirus nobis	Yellowstone National Park, Wyoming.
eltonclarki Merriam	Near Freshwater Bay, Chichagof Island, Alaska.
tahltanicus Merriam	Klappan Creek (=Third South Fork Stikine River), British Columbia.
insularis Merriam	Admiralty Island, Alaska.
orgilos Merriam	Bartlett Bay, east side Glacier Bay, Southeastern Alaska.
orgiloides nobis	Italio River, Alaska.
pallasi Merriam	Donjek River, southwestern Yukon.
rungiusi rungiusi nobis	Rocky Mountains, headwaters Athabaska River, Alberta.
rungiusi sagittalis nobis	Champagne Landing, southwestern Yukon.
macfarlani nobis	Anderson River, 50 miles below Fort Anderson, Mackenzie.
canadensis Merriam [2]	Moose Pass, near Mount Robson, British Columbia.

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[1] Nearly 130 years ago Prof. Zauschner proposed the name *Ursus saribur* for an animal "from the region of Canada" (Bestimmung der Hundsart Krokute, und der Bärenart Saribur, p. 8, 1788), but the species appears to be impossible of identification.

[2] Reference to group provisional.

Arizonæ group (pp. 53–76):

Ursus arizonæ Merriam	Escudilla Mountains, Apache County, Arizona.
idahoensis nobis	North Fork Teton River, eastern Idaho.
pulchellus pulchellus nobis	Ross River, Yukon.
pulchellus ereunetes nobis	Beaverfoot Range, Kootenay District, British Columbia.
oribasus nobis	Upper Liard River, Yukon.
chelan Merriam	East slope Cascade Mountains, Chelan County, Washington.
shoshone Merriam	Estes Park, Colorado.
kennerleyi Merriam	Mountains of northeastern Sonora, near Los Nogales, Mexico.
utahensis Merriam	Salina Creek, near Mayfield, Utah.
perturbans nobis	Mount Taylor, northern New Mexico.
rogersi rogersi nobis	Upper Greybull River, Absaroka Mountains, Wyoming.
rogersi bisonophagus nobis	Black Hills (Bear Lodge), northeastern Wyoming.
pervagor Merriam	Pemberton Lake (now Lillooet Lake), British Columbia.
caurinus Merriam	Berners Bay, east side Lynn Canal, Southeastern Alaska.
eulophus Merriam	Admiralty Island, Southeastern Alaska.
klamathensis Merriam [1]	Beswick, near mouth Shovel Creek, Klamath River, northern California.
mendocinensis Merriam [1]	Long Valley, Mendocino County, California.
magister Merriam [1]	Los Biacitos, Santa Ana Mountains, Southern California.

Hylodromus group (pp. 77–84):

Ursus hylodromus Elliot	Rocky Mountains, western Alberta.
kluane kluane Merriam	McConnell River, Yukon.
kluane impiger nobis	Columbia Valley, British Columbia.
pellyensis nobis	Ketza Divide, Pelly Mountains, Yukon.
andersoni nobis [1]	Dease River, near Great Bear Lake, Mackenzie.

Horriæus group (pp. 84–88):

Ursus apache Merriam	Whorton Creek, south slope White Mountains, eastern Arizona (a few miles west of Blue).
horriæus Baird	Copperminee, southwestern New Mexico.
henshawi Merriam	Southern Sierra Nevada, near Havilah, Kern County, California.

Stikeenensis group (pp. 88–94):

Ursus stikeenensis Merriam	Tatletuey Lake, tributary to Finlay River, near head Skeena River, British Columbia.
crassodon nobis	Klappan Creek (=Third South Fork Stikine River), British Columbia.
crassus nobis [1]	Upper Macmillan River, Yukon.
mirabilis Merriam [1]	Admiralty Island, Alaska.
absarokus Merriam [1]	Little Bighorn River, northern Bighorn Mountains, Montana.

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[1] Reference to group provisional.

Alascensis group (pp. 94–99):	
Ursus alascensis Merriam	Unalaklik River, Alaska.
toklat Merriam	Head of Toklat River, north base Alaska Range, near Mount McKinley, Alaska.
latifrons Merriam	Jasper House, Alberta.
Richardsoni group (pp. 99–106):	
Ursus richardsoni Swainson	Shore of Arctic Ocean, west side Bathurst Inlet, near mouth of Hood River.
russelli Merriam [1]	West side Mackenzie River delta, Canada.
phæonyx Merriam	Glacier Mountain, Tanana Mountains, Alaska (about 2 miles below source of Comet Creek, near Fortymile Creek, between Yukon and Tanana Rivers).
internationalis Merriam	Alaska-Yukon boundary, about 50 miles south of Arctic coast.
ophrus Merriam	Eastern British Columbia (exact locality unknown).
washake Merriam	North Fork Shoshone River, Absaroka Mountains, western Wyoming.
Kidderi group (pp. 106–110):	
Ursus kidderi kidderi Merriam	Chinitna Bay, Cook Inlet, Alaska.
kidderi tundrensis Merriam	Shaktolik River, Norton Sound, Alaska.
eximius Merriam	Head of Knik Arm, Cook Inlet, Alaska.
Innuitus group (pp. 110–115):	
Ursus innuitus Merriam	Golofnin Bay, south side Seward Peninsula, northwestern Alaska.
cressonus Merriam	Lakina River, south slope Wrangell Range, Alaska.
alexandræ Merriam [1]	Kusilof Lake, Kenai Peninsula, Alaska.
Townsendi group (pp. 115–116):	
Ursus townsendi Merriam	Mainland of Southeastern Alaska (exact locality uncertain).
Dalli group (pp. 116–124):	
Ursus dalli Merriam	Yakutat Bay (northwest side), Alaska.
hoots Merriam	Clearwater Creek, a north branch of Stikine River, British Columbia.
sitkensis Merriam	Sitka Islands, Alaska.
shirasi Merriam	Pybus Bay, Admiralty Island, Alaska.
nuchek Merriam [1]	Head of Nuchek Bay, Hinchinbrook Island, Prince William Sound, Alaska.
Gyas group (pp. 124–127):	
Ursus gyas Merriam	Pavlof Bay, Alaska Peninsula.
middendorffi Merriam	Kodiak Island, Alaska.
Kenaiensis group (pp. 127–131):	
Ursus kenaiensis Merriam	Cape Elizabeth, extreme west end Kenai Peninsula, Alaska.
sheldoni Merriam	Montague Island, Prince William Sound, Alaska.

Vetularctos genus nobis (pp. 131–133):	
Vetularctos inopinatus nobis	Rendezvous Lake, northeast of Fort Anderson, Mackenzie.

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[1] Reference to group provisional.

DESCRIPTIONS OF SPECIES AND SUBSPECIES.

Horribilis Group.

URSUS HORRIBILIS HORRIBILIS Ord.

BIG PLAINS GRIZZLY.

(Pl. XIV.)

Ursus horribilis Ord, Guthrie's Geography, 2d Amer. Ed., pp. 291, 300, 1815 (Rhoads' reprint, 1894). Based on the white bear of Lewis and Clark, particularly the one from eastern Montana killed May 5, 1805, on the Missouri River, near the mouth of Poplar River (called by them Porcupine River, but not the same as the Porcupine of to-day, which is about 50 miles farther west).

Ursus ferox Rafinesque, Amer. Monthly Mag., I, p. 437, Oct., 1817 (*nomen nudum*).

"*Ursus ferox* Lewis & Clarck," Desmarest, Mammalogie, p. 164, Paris, 1820 (under *U. cinereus*).

Ursus cinereus Desmarest, Mammalogie, p. 164, Paris, 1820.

Ursus griseus Choris, Voyage Pittoresque autour du Monde, folio colored plate and text (unpaged), Paris, 1822.

Ursus candescens Ham. Smith, in Griffith's Cuvier, II, p. 229 and facing plate, 1827; ibid. V, p. 112, 1827.

Type locality.—Missouri River, a little above mouth of Poplar River, northeastern Montana.

Characters.—Size huge; skull long and massive; claws long, moderately or slightly curved, and smoothly polished; usually streaked lengthwise with whitish or yellowish, which increases with age until in some old individuals the claws are almost wholly white or whitish. Color variable, usually light.

Cranial characters.—*Old male* (topotype, No. 202739) from Breaks of Missouri River, about 100 miles north of Fort Miles, eastern Montana, April 4, 1890; killed and presented by E. S. Cameron and wife: Skull huge (total length, 400 mm.=15¾ inches); vault of cranium moderately arched; zygomata rather squarely spreading posteriorly, moderately outbowed, the squamosal part rather broadly expanded vertically; frontal shield rather broad, flattish, sloping gradually upward to apex, the posterior part broader than usual (not cut away on sides by incurving temporal ridges); sagittal crest long, straight on top, high posteriorly, reaching forward over posterior fourth of frontals; postorbital processes large, flat, and horizontally outstanding; rostrum high, ascending posteriorly; fronto-nasal region rather high but *distinctly dished* and somewhat sulcate; palate long, concave in cross section; postpalatal shelf broad and flat, well rounded on sides; underjaw large and rather massive; coronoid blade high, its apex not strongly produced posteriorly; ramus rather flat; diastema long.

Teeth large, especially lower canine and last upper and middle lower molar. *Skull of female* (No. 13245, from head of Big Porcupine Creek [not Porcupine River] between Musselshell and Yellowstone Rivers, eastern Montana): Of generalized grizzly type; large and rather massive; vault of cranium rather flat; braincase rather broad; frontal shield of moderate breadth, slightly convex, slightly depressed or sulcate between orbits, elongate-lyrate posteriorly; postorbital processes weak and slightly decurved; sagittal crest not yet reaching fronto-parietal suture; muzzle moderate or rather short; zygomata moderately spreading and rather angular; palate rather narrow. Teeth large; M^2 large and subrectangular.

Cranial comparisons.—Adult male (No. 202739, topotype) compared with two adult males of *bairdi*, one from near Cheyenne, southeastern Wyoming (Yountz), the other from Blue River, Summit County, Colorado (No. 203805): Size slightly larger; fronto-nasal region (interorbitally) *dished* instead of *elevated*, not compressed in front of orbits; frontal shield slightly broader, rising from plane of nasals (in *bairdi* continuing plane of nasals); palate longer and broader; postpalatal shelf much broader and more rounded on sides; mastoids short, appressed, vertical (in *bairdi* longer and divergent); meatus tube compressed between mastoid and glenoid (in *bairdi* not compressed); underjaw longer; ramus longer and flatter (much less swollen on outer side); coronoid blade less falcate (notch shallower); lower canine and last upper molar larger.

Male adult compared with male adult *absarokus* (type): Size decidedly larger; vault of cranium less arched; frontal shield rising more gradually; rostrum longer; palate broader and much longer; ramus much longer; meatus tube compressed between mastoid and glenoid (in *absarokus* not compressed). Teeth much larger, especially lower canine, last upper molar, and middle lower molar.

Remarks.—Until recently the absence of authentic specimens from the neighborhood of the type locality, in connection with the presence of several species of grizzly in Montana, caused an embarrassing uncertainty as to which species was entitled to the name *horribilis.* But the slow accumulation of material during the long period in which I have been engaged in a study of the group made it possible to map the ranges of some of the species with some degree of confidence; and finally, through the generosity of Mr. and Mrs. E. S. Cameron, of Marsh, Montana, I have been presented with a splendid skull of an old male *horribilis* from the Breaks of the Missouri, about 100 miles north of Fort Miles, Montana (practically the type locality). This skull proves that the huge buffalo-killing grizzly of the Great Plains bordering the Missouri in eastern Montana and the Dakotas—the "White Bear" of Lewis and Clark—is really the species to which Ord in 1815 gave the name *Ursus horribilis.*

Skull measurements.—Old male (No. 202739, from Missouri Breaks, eastern Montana): Basal length, 351; occipito-nasal length, 350; palatal length, 192; zygomatic breadth, 247; interorbital breadth, 86.

URSUS HORRIBILIS BAIRDI MERRIAM.[1]

BAIRD GRIZZLY.

Ursus bairdi Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 192–193, August 13, 1914.

Type locality.—Blue River, Summit County, Colorado.

Type specimen.—No. 203805, ♂ old, U. S. National Museum, Biological Survey collection (=3147, Warren collection).

Range.—Southern Rocky Mountain region from San Juan Mountains, southwestern Colorado, northward through Wyoming to Montana, and perhaps to southeastern British Columbia. Probably a mountain animal, while its neighbor *horribilis* was a plains species.

Characters.—Size large—in the Rocky Mountain region exceeded only, if at all, by *horribilis;* skull long, with narrow elevated fronto-nasal region; claws of moderate length, smooth.

Cranial characters.—*Old male* (type) from Blue River, Colorado, and a closely similar old male from Sabille Hole, Laramie County, southeastern Wyoming, a little north of Cheyenne: Size large; fronto-nasal region high and rather narrow; rostrum rather long, narrow, and strongly compressed in front of orbits; face long sloping; frontal shield flat, short pointed, faintly depressed medially; shield and nasals in essentially same plane except that anterior third of nasals is slightly upturned; postorbital processes large, outstanding, flat, and blunt; orbital rims prominent; sagittal crest moderately high posteriorly; temporal impressions short, incurved, beaded; zygomata strongly outbowed, squarely spreading posteriorly; lachrymal duct notching orbital rim; squamosal shelf short, arched over meatus, the free edge thickened; palate and postpalatal shelf of moderate breadth; mastoids rather long, divergent. Molars large, especially M^2.

Immature males, up to at least the fifth or sixth year, have rather narrow convex frontal shields with weak decurved postorbital processes, and may be recognized at once by the form of the fronto-nasal region, which is *high, narrow, and strongly pinched in* immediately in front of the orbits.

Cranial comparisons.—Old male compared with old male *horribilis* (No. 202739, from Missouri Breaks, eastern Montana): Size essentially the same; frontal shield slightly lower posteriorly, higher anteriorly, the point lyrate and more slender; fronto-nasal region elevated (never dished or sulcate between orbits); base of rostrum much more compressed laterally in front of orbits; palate narrower; mastoids longer and more divergent; meatus tube broadly rounded and free (not compressed between mastoid and glenoid); underjaw shorter; ramus more swollen on outer side; inferior border of ramus shorter and less upturned; coronoid blade more recurved, the apex narrower and reaching farther backward. Teeth similar but slightly smaller; M^1 and M^2 smaller and less massive.

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[1] Named for S. F. Baird, former Secretary of the Smithsonian Institution and founder of the U. S. National Museum.

Skull measurements.—Old male (type): Basal length, 348; occipitonasal length, 325; palatal length, 157; zygomatic breadth, 235; interorbital breadth, 81.

URSUS HORRIBILIS IMPERATOR MERRIAM.

YELLOWSTONE PARK BIG GRIZZLY.

Ursus imperator Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 180–181, August 18, 1914.

Type locality.—Lake Hotel, Yellowstone National Park, Wyoming.

Type specimen.—No. 176297, ♂ old, U. S. National Museum. Died in National Zoological Park.

Range.—Yellowstone National Park, Wyoming; limits unknown.

Characters.—Size large; skull massive, with large horizontally outstanding postorbitals; closely similar to *horribilis*.

Cranial characters.—Old male (type) and a much finer male (No. 216205): Size large (only slightly smaller than *horribilis*); skull massive; vault of cranium rather high; fronto-nasal region moderately dished; sagittal crest long, high, and straight; frontal shield exceedingly short, flattish, shallowly sulcate medially, slightly swollen over orbits, ending in short obtuse point about 30 millimeters behind plane of postorbitals; postorbitals long, peglike, horizontally outstanding; lachrymal duct opening on orbital rim; zygomata moderately outstanding and outbowed, the squamosal base broadly expanded; squamosal shelves broad, arched over meatus; palate moderate; postpalatal shelf rather long; occipito-sphenoid 91 mm.; mastoids short; underjaw large, long, and massive, with high vertical coronoid blade. Teeth large: M^2 with long heel.

Cranial comparisons.—Two old males (Nos. 176297 and 216205) from near northern boundary of Yellowstone National Park[1] compared with an old male topotype of *horribilis* (No. 202739) from Missouri Breaks, eastern Montana: Size only slightly less, general appearance essentially same; frontal shield slightly broader interorbitally and decidedly broader across postorbital processes; postorbital processes more widely outstanding horizontally; palate and postpalatal shelf narrower; mastoids less appressed (apex farther from glenoid surface, leaving broader space for tube of auditory meatus). Last upper molar somewhat smaller, heel equally long but narrower posteriorly; middle lower molar narrower.

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[1] While both are old males, the type is the older of the two and the recessive changes incidental to senility have already begun. It differs from the other in having the frontal shield shorter pointed posteriorly (with consequent lengthening of sagittal crest), the rostrum narrower, the fronto-nasal region more strongly dished.

Old males (type and topotype) compared with old male *bairdi:* Size essentially same; frontal shield broader throughout; distance between tips of postorbital processes much greater; fronto-nasal region more dished (in *bairdi* elevated) and less compressed; inion more strongly developed.

Old male (type) compared with adult male *absarokus* (type): Size slightly larger; frontal shield broader and flatter; postorbital processes longer and more widely outstanding; rostrum higher and more nearly horizontal (in *absarokus* lower anteriorly and more sloping); sagittal crest longer; squamosal root of zygoma very much more expanded vertically; palate much longer.

Skull measurements.—Old male (type): Basal length, 336; occipito-nasal length, 317; palatal length, 191; zygomatic breadth, 232; interorbital breadth, 90. Another and more perfect old male from Yellowstone Park (No. 216205): Basal length, 340;[1] occipito-nasal length, 332; palatal length, 186; zygomatic breadth, 230; interorbital breadth, 90.

URSUS CHELIDONIAS sp. nov.

Jervis Inlet Grizzly.

Type No. 223133, ♂ old, U. S. National Museum, Biological Survey collection. Collected on river at head of Jervis Inlet, British Columbia, in 1916, by Forrest and Fred Johnstone.

Characters.—Size very large; external characters unknown; skull of male strikingly like that of *imperator* but teeth, especially upper molars, very much smaller, resembling those of *kwakiutl.*

Cranial characters.—*Adult male* (type): Skull very large, massive, flat on top, with horizontally outstanding or slightly uplifted postorbital processes; shield moderately broad, flat, the point long, reaching back to fronto-parietal suture; rostrum elevated in same plane with shield; sagittal crest short, confined to parietals; zygomata moderately outstanding and outbowed; nares small; postpalatal shelf rather broad; occipito-sphenoid unusually long (102); basicranial axis flat; mastoids long and spreading; meatus tubes large and free; underjaw large and massive; coronoid blade high and nearly vertical; ramus rather broad posteriorly, its inferior border concave under anterior molar, convex behind plane of last molar; subangular border short; canines moderate, rather small for size of skull; upper and lower molars small; heel of M^{2} short and rather broadly rounded; last lower premolar of grizzly type.

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[1] In part restored.

Cranial comparisons.—Ursus chelidonias requires comparison with only two species, *imperator* and *warburtoni*. Adult male (type) compared with equally old male *imperator* from Hell Roaring Creek near northern boundary of Yellowstone National Park: Size slightly greater; general form and proportions almost identical; point of shield somewhat longer; rostrum more completely in frontal plane; zygomata more outbowed anteriorly; basicranial axis flatter (in *imperator* somewhat arched); mastoids longer and more divergent; meatus tube longer; postpalatal shelf broader; coronoid blade higher; canines about same size; molars (both upper and lower) smaller, the difference most marked in M^{1}, M^{2}, and $M_{\overline{1}}$.

Compared with two adult males of *warburtoni*, one (No. 223946) from Iskut River near its junction with the Stikine; the other (No. 210142) from Chilkat River valley, Southeastern Alaska: Skull as a whole slightly larger; frontal shield more nearly horizontal, somewhat broader, and completely flat (in *warburtoni* slightly convex); zygomata more outbowed anteriorly; postpalatal shelf broader; basicranial axis flatter; occipito-sphenoid longer (102 mm., contrasted with 95); palate longer; postpalatal shelf broader; underjaw more massive; coronoid blade higher (posterior part of jaw more uplifted, raising condyle and coronoid); upper canines conspicuously more slender; lower canines much smaller; upper and lower molars smaller; middle lower molar not only shorter but differing markedly in proportions, the posterior moiety small and narrow (14.5) in comparison with the anterior (17); $PM_{\overline{4}}$ more distinctly of grizzly type; $M_{\overline{1}}$ with saddle open (cusplet on inner side nearly obsolete).

Skull measurements.—Old male (type): Basal length, 346; occipitonasal length, 337; palatal length, 191; zygomatic breadth, 240; interorbital breadth, 91.

URSUS ATNARKO sp. nov.

Atnarko Grizzly.

Type No. 211452, ♂ ad., U. S. National Museum, Biological Survey collection. From Lonesome Lake,[1] Atnarko River, one of the upper forks of the Bella Coola, British Columbia. Collected in September, 1915, by E. H. Edwards.

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[1] Lonesome Lake is about 30 miles from the junction of the Whitewater, or Talchawko, and the Atnarko, which two rivers unite to form the Bella Coola. The Bella Coola is about 45 miles long. Lonesome Lake is nearly on the fifty-second parallel, and by the river about 75 miles from the head of Burke Channel.

Characters.—Size large; external characters unknown; skull of male long and narrow, similar in general to that of *kwakiutl* but much narrower; skull of female surprisingly different from that of *kwakiutl*, being long, low, and very narrow, while *kwakiutl* is exceptionally high and broad.

Cranial characters.—Adult male (type): Skull long, low, and narrow, highest in posterior frontal region; braincase anteriorly keeling into sagittal crest; shield narrow and rather sharp pointed posteriorly; postorbitals moderate, horizontally outstanding; rostrum long and slender, rising gradually into plane of shield; zygomata not widely outstanding; sagittal crest long; palate and postpalatal shelf long and narrow; lower jaw long; coronoid blade moderate; subangular border short. Dentition weak: canines small for size of skull (as in *kwakiutl*); molars even smaller than in *kwakiutl*. *Adult female* (based on 3 adult and old females, Nos. 223177, 223182, and 223183) from Atnarko River: Skull long, low, slender, nearly flat on top; shield long and narrow, not rising above plane of rostrum; postorbitals weak, outstanding; rostrum long and slender, passing insensibly into frontal plane; zygomata appressed; palate long and narrow; coronoid blade moderate; subangular border short. Dentition weak.

Cranial comparisons.—Compared with *kwakiutl* the skull as a whole is longer and narrower; frontal shield much narrower and more evenly sloping (rising less abruptly from rostrum); postorbitals much less widely outstanding; posterior frontal region higher, keeling into sagittal crest; palate and postpalatal shelf notably longer and narrower.

Adult and old female compared with old female *kwakiutl* of slightly greater basal length: Breadth very much less (across postorbitals 105 or less, contrasted with 130); shield low, narrow, and flat instead of broad, high, and rising abruptly from rostrum; postorbitals much smaller and weaker; zygomata appressed instead of outstanding; palate, postpalatal shelf, and palatal notch very much narrower; sagittal crest much weaker.

Remarks.—The males of *kwakiutl* and *atnarko* are so much alike that their differences would naturally be regarded as of only subspecific weight; but the females are so strikingly different that it seems necessary to give them independent specific rank. Their specific distinctness is the more certain by reason of the geographic contiguity of the localities where they were killed, the type localities being on the same watercourse and not more than 75 miles apart.

Skull measurements.—Adult male (type): Basal length, 345;[1] occipito-nasal length, 325; palatal length, 199; zygomatic breadth, 214; interorbital breadth, 75.

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[1] Partly restored.

URSUS KWAKIUTL Merriam.

Kwakiutl Grizzly.

Ursus kwakiutl Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 143–144, September 6, 1916.

Type locality.—Jervis Inlet, coast of southern British Columbia.

Type specimen.—No. 211748, ♂ ad., U. S. National Museum, Biological Survey collection. Collected May 17, 1916, by Fred Mansell.

Range.—Coast region of British Columbia from southwestern corner (Burrard Inlet, Howe Sound, Jervis Inlet) northwesterly to or beyond the lower Bella Coola.

Characters.—Size large; color dark; ears densely furred; claws unknown; skull long, but little arched.

Color.—Skin of head of adult male (type): Nose brown; head and face from front of eyes posteriorly very dark brown, darkest on ears, slightly grizzled on occiput by golden-tipped hairs.

Cranial characters.—*Adult male* (type): Size large; skull long, rather low and narrow, with long high rostrum, gradually ascending frontal shield, rather low fronto-parietal region, and strongly outstanding postorbitals. Frontal shield of moderate breadth, shallowly sulcate medially, swollen over orbits, short pointed posteriorly; rostrum long, high, and rather narrow; nasals flattened, nearly horizontal; fronto-nasal region sloping gently in plane of shield; braincase long, its anterior part keeling into elongate sagittal crest; zygomata moderately spreading (becoming, of course, more strongly outbowed in old age); palate long, concave, slightly arched anteroposteriorly; postpalatal shelf large and broad, nearly square; dentition rather light for size of skull; underjaw long, its inferior border slightly sinuous (slightly bellied under last molars); coronoid blade broad at base, not very high, the apex slightly produced posteriorly but falling far short of plane of condyle.

Old female (No. 215432): The skull of an old female from Kwatna, on the lower Bella Coola, is obviously of this species. It is large and rugged for a female, with strongly dished fronto-nasal region and broad massive frontal shield rising abruptly from a very small rostrum; shield sulcate, swollen between sulcus and orbits, lyrate pointed, ending at fronto-parietal suture; postorbitals large and outstanding; zygomata outstanding; sagittal crest strongly developed for a female; palate and postpalatal shelf very broad; teeth small; $PM_{\overline{1}}$ badly worn but apparently subconical, as in a male (No. 215433) from the same locality.

Cranial comparisons.—The only species requiring comparison with *kwakiutl* are the much larger *nortoni* and the very different *pervagor*. Adult male (type) compared with adult male *nortoni* (No. 213705) from southeast side Yakutat Bay: Similar in general but much shorter; rostrum slightly longer; *braincase materially shorter;* shield much less elevated; fronto-nasal region much less dished; *postpalatal length much less.* Compared with male *pervagor:* Skull longer and less highly arched; braincase and rostrum materially longer; frontal shield shorter pointed posteriorly; rostrum more elevated anteriorly; nasals more nearly horizontal, shorter posteriorly, longer anteriorly; postpalatal notch longer; underjaw decidedly longer and more massive, but inferior border of ramus from symphysis to tubercle of essentially same length; subangular border much longer. Dentition heavier (both upper and lower canines, incisors, and molars larger).

Skull measurements.—Adult male (type): Basal length, 340; occipito-nasal length, 330; palatal length, 184; zygomatic breadth, 212; interorbital breadth, 85.

URSUS NORTONI[1] MERRIAM.

YAKUTAT GRIZZLY.

(Pl. XIII.)

Ursus nortoni Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 179–180, April 13, 1914.

Type locality.—Near Yakutat village, southeastern side Yakutat Bay, Alaska.

Type specimen.—No. 178763, ♀ ad., U. S. National Museum, Biological Survey collection. (Mother of ♂ cub of second year, No. 178764.) Collected May 15, 1910, by G. Frederick Norton.

Range.—Limited apparently to coastal plain on southeastern side of Yakutat Bay.

Characters.—A true grizzly, apparently of the *californicus-kwakiutl* group; of large size, with smoothly polished horny claws. Fourth lower premolar large and of ultra-grizzly type (long heel with continuous sulcus and complete lateral ridges ending in upturned posterior cusplets); molars, especially M^2, small for size of skull. Coloration normal for a grizzly; skull large, massive, and very broad.

Color.—Of pale grizzly type; head grizzled yellowish or golden brown; muzzle pale brown; neck and shoulders to middle of back pale buffy from the long whitish buff-tipped hairs, giving the skin viewed from behind a decidedly whitish appearance; hinder back and rump dark, well washed with pale brown tips; lower part of legs and feet dark brown; back of fore feet browner and not so dark; underchin and throat pale soiled buffy whitish.

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[1] Named for G. Frederick Norton, who collected and presented the type specimen.

Cranial characters.—*Adult male* (No. 213705, from southeast side of Yakutat Bay, northeast of Yakutat village): Skull large, long, massive, and strongly dished; braincase exceptionally long; facial part of skull relatively short; frontal shield rather broad, moderately convex transversely and sulcate medially (swollen between sulcus and postorbitals), rising strongly and abruptly from rostrum; postorbital processes well developed, slightly arched; rostrum rather short, horizontal; zygomata moderately spreading, outbowed; sagittal crest highly developed; squamosal shelves broad and long; palate and postpalatal shelf rather long and of moderate breadth; palate troughed between molar series; mastoids moderate; underjaw massive; coronoid blade high, broad, and not recurved; ramus long and straight. Teeth small for size of skull; M^2 rather short, the heel evenly emarginate and broadly rounded posteriorly.

Adult female (type): Rather massive, moderately dished, broad, with large broadly rounded braincase, bowed (but not widely outbowed and not angular), moderately spreading zygomata; short weak sagittal crest confined to posterior half of parietals; rather broad lambdoid crest defining a rather broadly open groove or sulcus continuous with that of the deeply sulcate and broadly expanded horizontal shelf of the squamosal; squamosal base of zygoma moderately expanded; frontal shield broad and long, its lyrate point reaching back to middle of parietals, broadly sulcate between orbits; frontonasal region moderately dished; postorbital processes large and broadly outstanding, infraorbital process of jugal and infrajugal process of maxillary well developed (probably not constant); rostrum broad, short, and rather depressed; lachrymal opening within orbit; palate and postpalatal shelf broad, the palate rather deeply concave from incisive foramina to plane of hind molars; postpalatal notch broad and rather squarely truncate; occipito-sphenoid length 90 (about equal to distance from posterior rim of alveolus of outer incisor to front of last upper molar); basioccipital considerably longer than basisphenoid; occiput broad, rather low, truncate; coronoid blade rather high. Basicranial axis nearly straight and horizontal, parallel to palatal axis. Dentition light in both sexes; canines and molars rather small for size of skull; $PM_{\overline{4}}$ of ultra grizzly type, with slender cone, well-developed completely sulcate heel ending posteriorly in pair of upturned cusplets; PM^4 large and broad; heel of M^2 rather short, not strongly narrowed posteriorly, third cusp small; incisors rather large.

Cranial comparisons.—Male adult (type) compared with male adult *kwakiutl* (type): Similar in general *but very much longer* both basally and on top; rostrum slightly shorter; braincase *materially longer;* frontal shield rising higher and more abruptly from rostrum; fronto-nasal region more conspicuously dished; *postpalatal length very much greater;* underjaw longer and more massive; ramus longer; subangular border shorter; coronoid blade much larger and higher; teeth closely similar, but upper canines and upper molars slightly larger.

Specimens examined.—About a dozen specimens have been examined, mainly females and young, all from the coastal plain southeast of Yakutat Bay. Three (including type) were collected by G. Frederick Norton, and by him presented to the Biological Survey; others were collected by Miss Annie M. Alexander, and are in the Museum of Vertebrate Zoology, University of California; still others (including a splendid adult male) were obtained from Yakutat Indians by E. M. Axelson and purchased by me. The localities are: Peninsula between Yakutat and Disenchantment Bays (northeast of Yakutat village); near Yakutat village; front of Yakutat Glacier; Ankow River; Setuk River; and Anklin River.

Skull measurements.—Adult male (No. 213705): Basal length, 353; occipito-nasal length, 346; palatal length, 185; zygomatic breadth, 241; interorbital breadth, 91. Adult female (type): Basal length, 306; occipito-nasal length, 284; palatal length, 165; zygomatic breadth, 210; interorbital breadth, 80.5.

URSUS WARBURTONI[1] MERRIAM.

WARBURTON PIKE GRIZZLY.

Ursus kwakiutl warburtoni Merriam, Proc. Biol. Soc. Washington, XXIX, p. 145, September 6, 1916.

Type locality.—Atnarko River, British Columbia.

Type specimen.—No. 210576, ♂ old, U. S. National Museum, Biological Survey collection. Collected July 15, 1915, by E. H. Edwards.

Range.—Coast region (but perhaps not the immediate coast strip) of Southeastern Alaska and adjacent parts of British Columbia from Chilkat River southeasterly to Atnarko River, one of the upper forks of the Bella Coola (skulls of adult males examined from Atnarko River, Stikine River, Iskut River near junction with Stikine, and Chilkat River valley).

Cranial characters.—*Adult males:* Skull large and massive, rather long and flattish on top, not arched. Similar to male *kwakiutl* but with much broader (less peglike) and flatter postorbitals, flatter frontal shield (not deeply concave in old age), much shorter sagittal crest, somewhat heavier dentition, especially broader and more massive

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[1] Named in honor of the late Warburton Pike, author of The Barren Grounds of Northern Canada, and The Subarctic Forest, who obtained a fine large typical skull (No. 223946) on the Iskut a few miles from its junction with the Stikine.

M2. Easily distinguished from *stikeenensis* of the same region by the much greater length of skull and underjaw and lesser elevation of frontal region.

Skull measurements.—Old male (type): Basal length, 340; occipito-nasal length, 324; palatal length, 185; zygomatic breadth, 233; interorbital breadth, 85. Old male (No. 223946) from Iskut River, a branch of the Stikine: Basal length, 326; occipito-nasal length, 340; palatal length, 176; zygomatic breadth, 230; interorbital breadth, 86.5.

URSUS NEGLECTUS Merriam.

Admiralty Island Grizzly.

Ursus kwakiutl neglectus Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 144–145, September 6, 1916.

Type locality.—Near Hawk Inlet, Admiralty Island, Southeastern Alaska.

Type specimen.—No. 209889, ♂ old, U. S. National Museum, Biological Survey collection. Collected April, 1914, by W. H. Spaulding.

Cranial characters.—Skull rather large and massive, flat topped, with rather broad outstanding postorbitals. Frontal shield moderate, flattish, shallowly sulcate, rather short pointed; fronto-nasal region elevated in plane of shield and slightly compressed; rostrum moderate, high; zygomata moderately outstanding and somewhat bowed; postpalatal shelf short and broad; notch rather broad. Underjaw rather short, ramus rather flat and broad vertically, especially posteriorly, strongly bellied posteriorly; coronoid blade high and narrow, its apex not reaching plane of condyle. Teeth moderate.

Cranial comparisons.—*Ursus neglectus* requires comparison with both *kwakiutl* and *warburtoni*. Old male (type) compared with adult male *kwakiutl* (type from Jervis Inlet): Size similar; shield flatter, more nearly horizontal and less sloping anteriorly; postorbitals broader and flatter on top; fronto-nasal region elevated instead of depressed; rostrum larger and more elevated; zygomata less outbowed; nasals more produced anteriorly, projecting broadly over nares (about 7 mm. beyond premaxillæ at point of contact); nares more truncate; underjaw and subangular border much shorter; coronoid blade narrower. Upper canines and crown of last upper molar longer.

Old male (type) compared with three old males of *warburtoni* (from Atnarko and Iskut Rivers and Chilkat Valley): Size slightly smaller but occipito-sphenoid length same; top of skull more nearly horizontal (shield anteriorly and rostrum more elevated); zygomata less outbowed; nasals more projecting anteriorly; palate shorter; postpalatal shelf broader, flatter, and much shorter; mastoids shorter; underjaw slightly smaller; subangular border much shorter; coronoid blade narrower and more nearly vertical. Canines (especially upper) more slender; M^1 narrower and less massive but difference not great.

Skull measurements.—Old male (type): Basal length, 322; occipito-nasal length, 325; palatal length, 177; zygomatic breadth, 229; interorbital breadth, 83.

URSUS CALIFORNICUS MERRIAM.

CALIFORNIA COAST GRIZZLY.

[*Ursus horriæus*] subspecies *californicus* Merriam, Proc. Biol. Soc. Washington, X, pp. 76–77, April 13, 1896.

Ursus californicus Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 186, 188, August 13, 1914.

Type locality.—Monterey, California.

Type specimen.—Skull No. 3630, ♂ old, U. S. National Museum.

Range.—Humid coast region of California from San Francisco Bay south about to San Luis Obispo (apparently passing into *tularensis* in the dryer interior).

Characters.—Size large; claws long and smooth; pelage variable. Dentition heavy; last upper molar large, its heel long and broad.

Cranial characters.—Adult male: Skull long and narrow; vault of cranium flat—not arched; frontal shield flat (or concave medially), short pointed posteriorly, gradually sloping almost in same plane with rostrum (dishing slight); temporal impressions beaded; postorbitals massive and moderately spreading; zygomata slightly bowed; rostrum long, slightly compressed in front of orbits; nasals nearly horizontal, slightly rising posteriorly in plane of shield; frontal shield moderately broad, slightly swollen over orbits, the point lost in sagittal crest 25 to 50 mm. anterior to fronto-parietal suture; postorbital processes strongly developed, subtriangular, rather massive, outstanding, and slightly decurved over orbits; sagittal crest strongly developed and nearly straight; squamosal shelf broad; squamosal base of zygoma vertically expanded in aged skulls; frontal part of braincase in young-adult skulls somewhat elevated and tending to "keel" into crest; mastoid processes long; interpterygoid fossa long and usually narrow; underjaw long and massive, ramus broad vertically. Teeth large and heavy; M^2 subrectangular, heel long, broad posteriorly. *Skull of female:* Similar to that of male, but smaller.

Cranial comparisons.—Adult and old male compared with adult male *klamathensis* (type): Skull longer; zygomatic breadth essentially the same; face and rostrum longer; rostrum more compressed in front of orbits; fronto-nasal region more dished; frontal shield more concave medially and more swollen at orbital rims; postorbital processes much more massive, slightly arched, the tips slightly decurved; temporal beads more strongly incurved; sagittal crest shorter posteriorly; lambdoid crest more outstanding laterally; occipital overhang much less; squamosal shelf behind zygoma much shorter; occipito-sphenoid and palate longer; mastoids much longer and more strongly outstanding. Underjaw much longer. Dentition heavier, the last upper and middle lower molar in particular much larger; heel of M^2 very broad and broadly rounded posteriorly.

Old male from Monterey, compared with old male *colusus* (type, from Sacramento River): Fronto-nasal region slightly higher and less depressed; rostrum higher, less depressed, and less horizontal; postorbitals much larger and more swollen; orbital rims more swollen; orbits more nearly vertical, squamosal base of zygoma more expanded; palate narrower anteriorly; ramus much broader vertically, its inferior border less convex in middle part and more bellied posteriorly; apex of coronoid more produced posteriorly; angular process larger and longer; mastoids longer and directed less anteriorly, not reaching so near glenoid process. Dentition stronger and strikingly different: canines larger; upper incisors and both upper and lower molars very much larger; heel of M^2 large and not normally emarginate.

Skull measurements.—Old male (type): Basal length, 361; occipito-nasal length, 346; palatal length, 196; zygomatic breadth, 224; interorbital breadth, 82.

URSUS TULARENSIS MERRIAM.

TEJON GRIZZLY.

Ursus californicus tularensis Merriam, Proc. Biol. Soc. Washington, XXVII, p. 188, August 13, 1914.

Type locality.—Fort Tejon, Cañada de las Uvas, Tehachapi Mountains, California.

Type specimen.—No. 3536, ♂ old, U. S. National Museum. Collected by John Xantus.

Range.—Dry chaparral hills of interior coast ranges between the San Joaquin Valley and Los Angeles plain, comprising the Tehachapi, Tejon, Sierra Madre, and San Gabriel Ranges, and probably San Bernardino Mountains also, and ranging northward an unknown distance, doubtless covering the San Rafael and Gabilan Ranges, and southern part of the Diablo Range; limits unknown.

Characters.—Size large, but smaller than *californicus;* claws of grizzly type, but those of a female dark, thick, and broad for a female, rather straight (tips worn off), straighter and broader than in female *magister*.

Color.—Nearly full-grown male killed by Walter Richardson, near head of Tejunga Canyon, San Gabriel Mountains, Southern California, in 1897: General color very dark brown, almost dusky; grizzled on upperparts by admixture of pale-tipped hairs; muzzle reddish brown.

Cranial characters.—*Old male:* Skull large, rather broad and flat frontally, moderately dished, moderately high, with large outstanding postorbitals and beaded temporal ridges. Frontal shield rather broad, swollen, and somewhat elevated on orbital rims and base of postorbitals, depressed interorbitally, sloping gradually into rostrum; rostrum large and rather high; fronto-nasal region not depressed; sagittal crest rather short, elevated and produced posteriorly; occipital overhang marked; zygomata moderately spreading, subtriangular; palate and postpalatal shelf broad and flat, mastoids rather long and inclined strongly forward. Underjaw large and rather massive; ramus broad vertically, strongly bellied posteriorly; coronoid rather high, its apex not strongly recurved. Teeth large; M^2 subrectangular, the long heel only slightly emarginate on outer side. *Adult and old females:* Skulls more easily distinguished than in males from their nearest relative, *californicus*. The skull of the female is much more like the normal female grizzly type, not resembling the males as does the female of *californicus*.

Cranial comparisons.—Adult and old females compared with female *californicus:* Skull decidedly smaller; frontal shield behind plane of postorbital processes more elevated and convex—not depressed and concave as in *californicus;* point of shield longer and broader; orbital rims more swollen; sagittal crest shorter and lower; palate at least 10 mm. shorter; occipito-sphenoid about 10 mm. shorter; underjaw smaller and lighter; last upper molar decidedly smaller. Normal M^2 subrectangular as in *californicus* (in *henshawi* subtriangular and small).

Adult and old males compared with male *californicus:* Similar but smaller; base of cranium shorter; palate slightly shorter; occipitonasal length decidedly less; braincase decidedly shorter; zygomatic breadth same or slightly greater—the skull as a whole relatively broader than in *californicus;* postpalatal shelf broader; underjaw materially shorter; M^1 decidedly smaller (both shorter and narrower); lower series of teeth smaller, $M_{\overline{1}}$ and $M_{\overline{2}}$ particularly smaller, much narrower and less massive; heel of last upper molar less broad than in *californicus*.

Adult male compared with *henshawi* (type): Skull larger and more massive; fronto-nasal region much higher and much less dished; rostrum larger, higher, and not depressed; zygomata more broadly spreading; postpalatal shelf broader; coronoid larger and less falcate; ramus broader vertically; last upper molar much larger, the heel long and broad posteriorly, contrasted with the short subtriangular heel of *henshawi*.

Skull measurements.—Average of two old males from Fort Tejon, California: Basal length, 329; occipito-nasal length, 320.5; palatal length, 179.5; zygomatic breadth, 228; interorbital breadth, 78. Old female from Fort Tejon: Basal length, 296; occipito-nasal length, 287; palatal length, 162; zygomatic breadth, 187; interorbital breadth, 75.

URSUS COLUSUS MERRIAM.

SACRAMENTO VALLEY GRIZZLY.

Ursus colusus **Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 187-188, August 13, 1914.**

Type locality.—Sacramento River valley, California (probably between Colusa and Sacramento).

Type specimen.—No. 3837, ♂ old, U. S. National Museum. Collected by the Wilkes U. S. Exploring Expedition and marked "C. P. Ex. Ex. 6.16" (the numerals uncertain, there being indication of a figure in front of the first 6). The words "Grizzly Bear, Sacramento" are written on the right parietal in pencil.

Range.—Sacramento (and perhaps also San Joaquin) Valley and adjacent foothills; westerly in the hot inner coast mountains to Dobbins Creek canyon on the boundary between southeastern Humboldt and southwestern Trinity Counties.

Characters.—Size large, external characters unknown. Skull large and long, resembling that of *californicus*, but teeth smaller and last upper molar very different.

Cranial characters.—*Old male:* Skull large, long, and low, the frontal shield flat, postorbital processes moderate or small, frontonasal region moderately dished, palate long, sagittal crest high, temporal ridges beaded, and occipital overhang pronounced. In general resembling largest skulls of *californicus* but having very much smaller teeth and differing in numerous minor cranial characters. *Young-adult female:* One from San Jose Mission (No. 1143, Yale Museum) appears to be a not quite grown female *colusus*. The last upper molar is short and subtriangular, the heel emarginate on outer side.

Cranial comparisons.—Old male (type) compared with old male *californicus* (from Monterey): Fronto-nasal region slightly lower and more depressed; rostrum lower, more depressed and more nearly horizontal; postorbitals much smaller and less swollen; orbital rims less swollen; orbits less nearly vertical; squamosal base of zygoma less expanded; palate broader anteriorly; ramus much less broad vertically, its inferior border more convex in middle part and less bellied posteriorly; apex of coronoid less produced posteriorly; angular process smaller and shorter; mastoids shorter and directed more anteriorly, reaching nearer to glenoid process. Dentition weaker and strikingly different: canines too badly broken to admit of satisfactory comparison, but obviously smaller; upper incisors and both upper and lower molars very much smaller; heel of M^2 small and strongly emarginate on outer side, of same size and approximately same form as in *klamathensis* but even more strongly constricted on outer side immediately behind second cusp; lower molars of same size as in *klamathensis* though the jaw is much longer.

Old male (type) compared with *klamathensis:* Postorbitals, length of sagittal crest, form of zygomata, and dentition essentially the same, but skull longer; vault of cranium *much lower;* frontal shield narrower and much shorter; temporal beads much more strongly incurved; fronto-nasal region dished instead of elevated; rostrum much lower, more depressed, and more nearly horizontal; ramus longer, less broad vertically; diastema much longer.

Skull measurements.—Old male (type): Basal length, 352; occipito-nasal length, 337; palatal length, 185; zygomatic breadth, 228; interorbital breadth, 82.5.

URSUS DUSORGUS sp. nov.[1]

RINDSFOOS GRIZZLY.

Type No. 217426, ♂ old, U. S. National Museum. **From head of Jack Pine River near Mount Bess, Alberta (close to British Columbia boundary). Collected September 4, 1916, and presented to the National Museum by William Rindsfoos.**

Cranial characters.—Skull large, broad, and massive, with flat gradually sloping frontal shield and high sagittal crest; shield broad, short pointed, slightly thickened at orbits, with horizontally outstanding slightly elevated postorbitals; fronto-nasal region faintly dished, the broad slightly depressed rostrum rising imperceptibly into shield; sinus case keeling into anterior part of sagittal crest, the crest rising above plane of top of skull and point of frontals and reaching forward nearly half way from fronto-parietal suture to postorbitals; temporal impressions strongly beaded; zygomata broadly outstanding; palate and postpalatal shelf rather broad; underjaw massive; ramus strongly bellied posteriorly; coronoid rather high. Teeth moderate; last upper molar long.

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[1] Tentatively included in *horribilis* group. (See Introduction, pp. 12–13.)

Cranial comparisons.—So far as known *dusorgus* requires comparison with only a single species—*imperator* of western Montana and the Yellowstone Park region. Old male (type) compared with old male *imperator* (No. 216205): Similar in general but size somewhat less; vault of cranium, frontal region, and rostrum lower; shield flatter, more strongly sloping, and shorter pointed; rostrum more depressed; sagittal crest much higher anteriorly, rising well above point of shield; palate shorter; meatus tube longer; ramus of jaw shorter. Teeth similar but M^1 smaller.

Skull measurements.—Old male (type): Basal length, 324; occipito-nasal length, 322.5; palatal length, 180; zygomatic breadth, 227; interorbital breadth, 86.

Planiceps Group.

URSUS NELSONI[1] MERRIAM.

NELSON GRIZZLY.

Ursus nelsoni Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 190–191, August 13, 1914.

Type locality.—Colonia Garcia, Chihuahua, Mexico.

Type specimen.—No. 99657, ♀ ad., U. S. National Museum Biological Survey collection. Collected November 13, 1899, by H. A. Cluff.

Range.—Sierra Madre of Mexico from northwestern Chihuahua and northeastern Sonora south to southern Durango.

Characters.—Smallest of the grizzly bears. General color, pale buffy yellowish, varying to grayish white, grizzled from darker color of underfur. Specimens in worn pelage vary to yellowish brown and even rusty. Hairs of throat and flanks longer than elsewhere; belly sparsely haired, lacking the thick underfur of upperparts. Claws long, smooth, and moderately curved; brownish horn color streaked with yellowish. Longest claw 56 mm. from upper base to tip (tip worn off).

Color.—Type specimen in fresh fall pelage: Muzzle pale brown, much darker around eyes; top of head yellowish buff; back grayish brown, heavily overlaid with pale buffy gray tips (color more buffy across shoulders, more whitish gray on back); hump dark brown, small; rump grizzled grayish and brown, the light-tipped hairs failing posteriorly and on the sides, the dark brown ground color passing into blackish brown on thighs, legs, feet, and tail; forelegs also blackish brown; lips and point of chin yellowish buff, followed by area of dark brown; underneck and underparts generally long haired and grizzled, the prevailing color yellowish buff.

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[1] Named for E. W. Nelson, who collected the original series in the type region.

Cranial characters.—Adult male: Skull small and wolflike. Similar in general to *texensis*, but smaller and more wolflike; rostrum strikingly narrow; frontal shield flat, narrow, and only faintly sulcate medially; temporal impressions not beaded; occipito-sphenoid length 82 mm. (in ♂ *texensis*, 86); palate very short (149 mm. contrasted with 171 in *texensis*); posterior root of zygoma slender; postorbital process slender, peglike, and outstanding horizontally. Teeth small.

Skull measurements.—Old male (No. 16025, Field Mus. Nat. Hist., Chicago, from Casas Grandes, Chihuahua): Basal length, 284; occipito-nasal length, 264; palatal length, 149; zygomatic breadth, 199; interorbital breadth, 65. Average of three adult females from Colonia Garcia, Chihuahua: Basal length, 260; occipito-nasal length, 243; palatal length, 138; zygomatic breadth, 168; interorbital breadth, 61.

URSUS TEXENSIS TEXENSIS Merriam.

Texas Grizzly.

Ursus horriæus texensis Merriam, Proc. Biol. Soc. Washington, XXVII, p. 191, August 13, 1914.

Type locality.—Davis Mountains, Texas.

Type specimen.—No. 203198, ♂ old, U. S. National Museum, Biological Survey collection. Killed November 2, 1890, by C. O. Finley and John Z. Means.

Range.—Restricted, so far as known, to Davis Mountains, Texas, and mountains of southern Colorado.

Characters.—Size small; external characters unknown. Affinities with *shoshone* rather than with *horriæus.*

Cranial characters.—Old male (type): Size small; frontal shield low, narrow, flat (slightly depressed medially), short pointed posteriorly, gently sloping in same plane with rostrum; postorbital processes small, peglike, horizontally outstanding; fronto-nasal region elevated in fronto-facial plane; rostrum narrow; zygomata rather broadly outbowed, moderately expanded vertically, lachrymal duct wholly anterior to orbit; sagittal crest long and nearly straight; occipital overhang marked; palate broad, deeply excavated between molars (may be abnormal); postpalatal shelf broad and flat; postpalatal notch broad and short; meatus tube slightly recurved and markedly upturned. Underjaw light; inferior border of ramus long, slightly bellied posteriorly; subangular border rather short; coronoid blade high, its recurved apex falling short of plane of condyle. Teeth rather small; M^2 small, with small heel obliquely narrowed on outer side.

Old female (No. 213002, from Navajo Range, near Cromo, Colorado): Skull short, dished, the braincase broad; frontal shield narrow; zygomata broadly spreading, slightly bowed; occiput truncate; and postorbitals slender, widely outstanding. Rostrum small, slender, tapering, rising posteriorly into flat lyrate shield; postorbital processes long, slender, and directed forward as well as outward; braincase rather broad and depressed; palate rather short; postpalatal shelf broad and flat. Teeth moderate; canines small and slender; molars nearly as large as in male, and M^2 of same form.

Cranial comparisons.—Adult male (type) compared with adult male *planiceps* (type): Size smaller throughout; shield much narrower, less flat, and less nearly horizontal; fronto-nasal region dished (in *planiceps* not dished); rostrum much smaller and narrower; palate deeply concave between posterior molars (in *planiceps* flat); ramus of underjaw more tapering anteriorly; angular processes not bellied (in *planiceps* bellied); teeth smaller.

Old male (type) compared with male *shoshone:* Size smaller; vault of cranium lower and more nearly horizontal; frontal shield less sloping; anterior part of braincase broadly depressed (not compressed or keeling into crest); palate broader. Teeth smaller.

Old male (type) compared with old male *horriæus* (type): Skull similar in basal length, but materially smaller, lower, flatter, narrower, more smoothly rounded, broader across squamosals, much less massive, and with wholly different postorbitals. Postorbitals small, slender, peglike, and horizontally outstanding instead of large, broad, massive, and decurved; frontal shield narrower and flatter; orbital rims less swollen; rostrum smaller (shorter and more slender); fronto-nasal region even less dished; palate somewhat broader between molars and deeply excavated between last molars (slightly depressed in *horriæus*); interpterygoid canal shorter; zygomata more widely outstanding posteriorly and bowed (in *horriæus* more angular and more outstanding anteriorly); inferior border of jaw (symphysis to subangular tubercle) much longer. Canines and molars smaller.

Old female (from Navajo Mountains) compared with old female *horriæus* (from mountains north of Silver City, N. Mex.): Skull as a whole and rostrum shorter; occiput doubtless more truncate (that of *horriæus* sawed off) frontal shield shorter and more dished; postorbitals longer, more slender, and directed anteriorly as well as outward; zygomata much more broadly spreading, more swollen at anterior base, and distinctly bowed instead of angular; palate broader, flat instead of concave; lower jaw thicker and heavier.

Skull measurements.—Old male (type): Basal length, 308; occipito-nasal length, 301; palatal length, 171; zygomatic breadth, 218; interorbital breadth, 71.

URSUS TEXENSIS NAVAHO MERRIAM.

NAVAHO GRIZZLY.

Ursus navaho Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 191–192, August 13, 1914.

Type locality.—Navajo country near Fort Defiance, Arizona (Mollhausen); type probably killed in 1856 in Chuska Mountains, on boundary between northeastern Arizona and northwestern New Mexico.

Type specimen.—No. 3500, ♂ old, U. S. National Museum.

Range.—Probably restricted to the isolated Chuska Mountains (including the so-called Lukachukki and Tunitcha elevations, and perhaps also the neighboring Carriso Mountains on the north).

Characters.—Size small; external characters unknown; skull short, broad and slightly dished.

Cranial characters.—*Old male* (type; badly damaged, only the front part with zygomata and underjaw remaining): Skull short; zygomata broadly spreading and outbowed, the anterior root much swollen, posterior root not expanded; frontal shield flat, short pointed; postorbital processes peglike and outstanding; temporal impressions finely beaded; rostrum short and small; nares rather small and nearly vertical; lachrymal duct opening on orbital rim, but more in than out; palate broad for so small a skull; postpalatal shelf broad; coronoid blade high. Teeth small: M^1 very small; M^2 short, with broadly rounded heel (tooth nearly as broad posteriorly as in middle and anteriorly).

Cranial comparisons.—Old male (type) compared with old male *texensis* (type): Size somewhat larger; frontal shield and rostrum broader; jugal longer posteriorly. Palate and postpalatal shelf much shorter (157 mm. contrasted with 173), and less deeply concave between posterior molars; postorbital processes slightly larger; anterior root of zygoma much more swollen (in *texensis* hardly swollen); nares much more truncate; underjaw straighter (less upcurved posteriorly); canines about same size; molar series slightly shorter; M^2 of same length but heel broadly rounded posteriorly instead of obliquely truncate, the sides of tooth nearly parallel; M^1, $M_{\bar{1}}$, and PM^4 smaller.

Skull measurements.—Old male (type): Palatal length, 157.5; interorbital breadth, 81. Skull too badly broken to furnish other measurements.

URSUS PLANICEPS SP. NOV.

FLAT-HEADED GRIZZLY.

Type No. 13289, ♂ ad. (rather old), U. S. National Museum, from Colorado (exact locality unknown). Collected by Dr. F. V. Hayden.[1]

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[1] Dr. Hayden worked in Colorado in 1869, mainly in the mountains and foothills of the east-central part of the State. Inasmuch as two other grizzlies, *bairdi* and *macrodon*, inhabit the higher mountains of Colorado it seems highly probable that the home of *planiceps* was in the foothills or along the western edge of the plains.

Cranial characters.—Adult male (type): Skull rather large, low, and flat; shield broad, flat, and nearly horizontal; postorbitals horizontally outstanding; rostrum broad, somewhat depressed; zygomata broadly outstanding and outbowed; palate, postpalatal shelf, and postpalatal notch broad; occipito-sphenoid long (95 mm.) Underjaw rather long; ramus flat and rather thin; condyle high, vertical; subangular border short; angular process bellied on underside. Canines moderate; molars rather large but much smaller than in *macrodon.*

Cranial comparisons.—Ursus planiceps requires comparison with its two neighbors, *macrodon* and *texensis*, of which its affinities are closest with *macrodon.* Old male (type) compared with old male *macrodon:* Size and vault of cranium about same; shield slightly broader and flatter; rostrum broader; zygomata very much more broadly outstanding and outbowed; palate, postpalatal shelf, and palatal notch much broader; posterior part of underjaw more upcurved, lifting condyle and coronoid; upper canines about same size; lower canines and upper and lower molars decidedly smaller.

Old male (type) compared with old male *texensis* (type): Size larger throughout; shield much broader, flatter, and more nearly horizontal; fronto-nasal region more elevated in plane of shield (not dished as in *texensis*); rostrum much larger, broader, and more massive; zygomata about the same but squamosal arm longer; palate flat (in *texensis* deeply concave between posterior molars); occipito-sphenoid longer; underjaw much more massive; ramus less tapering anteriorly; angular processes strongly bellied (in *texensis* not bellied); teeth larger.

Skull measurements.—Old male (type): Basal length, 319.5; occipito-nasal length, 305; palatal length, 173; zygomatic breadth, 215; interorbital breadth, 75.

URSUS MACRODON sp. nov.

Twin Lakes Grizzly.

Type skull No. 15707 (skin No. 12678), ♂ old, U. S. National Museum. From Twin Lakes, Colorado, July 28, 1876. Collected by C. W. Derry.

Characters.—Old male (type): Size large; hump evident; claws (worn short) large, broad, mainly yellowish on top, horn color on sides. Skull rather large and flat; last upper molar very large.

Color.—Type specimen: Peculiar for a grizzly, resembling some of the Alaska brown bears; general body color rich brown, almost reddish brown, darker on hump and lightly washed with pale tipped hairs on upper part of back; head rather uniform brown. *Adult female* (No. 203178) from South Branch Williams River, Colorado, killed September 13, 1895: General color very dark, almost black. Muzzle reddish brown with a golden tinge on top, becoming very dark brown on cheeks, chin, and around eyes; top of head dusky, overlaid by deep rich glossy hazel or between hazel and chestnut; top of neck and upperparts generally blackish, moderately washed with golden-tipped hairs; hump marked and nearly black; legs and feet nearly black; the long hairs below ears and on sides of neck washed with golden. Claws long, slender, and smoothly polished; dark horn color, paler toward tips and on sides. Longest claw from upper base 61 mm. (tip worn off; greatest breadth of claws 8 mm.).

Cranial characters.—Old male (type): Skull long, low, flat, and rather narrow; shield narrow, flat, nearly horizontal, sloping gradually into rostrum without noticeable dishing; zygomata not broadly outstanding; squamosal root long but not vertically expanded; palate long and narrow; postpalatal notch narrow; underjaw long; ramus straight, swollen on outer side below premolars; coronoid blade high; subangular border rather short; angular process bellied; canines and molars large; M^2 40 mm. in length; heel long, slightly emarginate.

Female from South Branch Williams River, Colorado (No. 203178, September 13, 1895, collected and presented by J. P. Bird): Skull similar to that of male but much smaller, with correspondingly narrower shield and rostrum, and slightly more dished fronto-nasal region; shield low, narrow, flat, and gently sloping, the point slender and remarkably short for a female, ending anterior to fronto-parietal suture; sagittal crest proportionately long but low anteriorly; postorbital processes small, slightly elevated, and directed slightly backward; orbital rims somewhat thickened; rostrum small; nasals anteriorly horizontal, posteriorly rising slightly and passing into frontal shield in same plane; zygomata moderately spreading, angular; palate and postpalatal shelf short. Canines very small; molars large; M^2 38 mm., which is materially larger than in males of *texensis* and *planiceps*.

Cranial comparisons.—Skull of old male (type) similar in general to old male *texensis* (type) but slightly larger, with longer, flatter, and more nearly horizontal frontal shield, and somewhat higher fronto-nasal region and rostrum; shield somewhat longer pointed; fronto-nasal region elevated in plane of shield (not dished as in *texensis*); postorbitals more broadly outstanding; rostrum broader and somewhat longer; opening of lachrymal duct within orbital rim (in *texensis* anterior to rim); zygomata less widely outstanding; squamosal root longer; postpalatal shelf narrower; palate flatter; underjaw more massive; ramus less tapering anteriorly; inferior border of angular process strongly bellied or keeled (may be individual); canines and molars very much larger throughout (especially M^2).

Remarks.—In size and general appearance *macrodon* resembles *planiceps*, but the frontal shield is more nearly horizontal; postorbital processes less widely outstanding; *zygomata much less broadly outstanding* and *not bowed;* squamosal arm of zygoma longer; canines and molars, particularly M^2, decidedly larger. It may prove to intergrade with *planiceps.*

Skull measurements.—Old male (type): Basal length, 312; occipito-nasal length, 302; palatal length, 171; zygomatic breadth, 202; interorbital breadth, 72.

URSUS MIRUS SP. NOV.

YELLOWSTONE PARK GRIZZLY.

Type No. 206595, ♂ ad. (rather old), U. S. National Museum, Biological Survey collection. From Slough Creek, Yellowstone National Park, March 27, 1915. Collected by Henry Anderson.

Cranial characters.—*Old male* (type): Size medium; skull long, rather narrow and low arched; shield rather narrow and flat, nearly horizontal postorbitally, anteriorly sloping gently into rostrum; postorbitals long, slender, and horizontally outstanding; rostrum high, subterete above; nares high; zygomata widely outbowed; squamosal root arched and broadly expanded; palate and postpalatal shelf narrow; mastoids vertical; underjaw moderate, swollen on lower part of outer side under diastema; subangular border rather long and sloping upward posteriorly. Teeth of medium size.

Cranial comparisons.—Old male (type) compared with old male *tahltanicus* (type): Basal length and vault of cranium essentially same; occipito-nasal length greater; shield and rostrum flatter; zygomata more outbowed; squamosal arm of zygoma longer and more broadly expanded; underjaw slightly longer; coronoid blade narrower in middle part; inferior border of ramus of same length; subangular border longer.

Old male (type) compared with old male *planiceps* (type): Size essentially same except that the rostrum is decidedly narrower and more elevated anteriorly; point of shield slightly more elevated; shield more sloping; postorbitals longer; rostrum narrower, higher, and subterete instead of flattened above; palate and postpalatal shelf narrower; zygomata even more strongly outbowed; occipito-sphenoid shorter; subangular border of lowerjaw longer; angular processes not bellied; teeth about same size.

Old male (type) compared with old male *texensis* (type): Similar in general characters but somewhat larger; vault of cranium slightly higher; rostrum much higher anteriorly and more nearly horizontal; nares much higher; postorbitals more slender and much more widely outstanding (121 contrasted with 104); posterior frontal region less elevated; zygomata more outbowed (less triangular); squamosal root of zygoma much more broadly expanded; postpalatal shelf narrower; underjaw larger and longer; ramus less tapering anteriorly; subangular border somewhat longer.

Old male (type) compared with old male *shoshone* (type), with which it agrees in basal length: Vault of cranium lower; shield lower posteriorly and much less strongly sloping; rostrum higher anteriorly and more nearly horizontal; nares higher; sinus case not definitely keeling into sagittal crest; zygomata much more broadly outstanding and outbowed; squamosal root much more broadly expanded; postpalatal length less; canines[1] and molars closely similar.

Compared with old male *idahoensis* (type): Skull, palate, and rostrum longer; basicranium and vault less arched; squamosal arm of zygomata longer and more broadly expanded.

Remarks.—The cranial characters indicate that *mirus* of the Yellowstone Park region is rather closely related to *tahltanicus* of the Stikine region, and also, though apparently less closely, to *planiceps* of Colorado and southern Wyoming. It is so much smaller and has teeth so much smaller than *horribilis* and *imperator* that comparison in detail is unnecessary; and compared with *absarokus* the skull is so much lower, flatter, and narrower and the teeth so much smaller that the two can not be confused.

Skull measurements.—Old male (type): Basal length, 315; occipito-nasal length, 307; palatal length, 174; zygomatic breadth, 220; interorbital breadth, 77.

URSUS ELTONCLARKI[2] MERRIAM.

SITKA GRIZZLY.

Ursus eltonclarki Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 175–176, August 13, 1914.

Type locality.—Near Freshwater Bay, Chichagof Island, the more northern of the Sitka Islands, Alaska.

Type specimen.—No. 179066, ♂ ad., U. S. National Museum, Biological Survey collection. Collected May 19, 1912, by Elton Clark and by him presented to the Biological Survey.

Range.—The Sitka Islands, Baranof and Chichagof.

Characters.—A grizzly of medium or rather small size; skull small, long, narrow, and rather low, with flat frontal shield. Claws of true grizzly type, smoothly polished, strongly curved and rather short; longest claw (in type specimen) from upper base 70 mm.; dark bluish or plumbeous horn color streaked with whitish or yellowish.

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[1] In the type specimen of *shoshone* the canines are absent, but they are present in a young male, No. 113410, from Marvine, Colorado, affording the desired comparisons.

[2] Named in honor of Elton Clark, of Boston, who killed and presented the type specimen.

Color.—Color of type very dark and rich. Nose pale brown, darkening just in front of eyes; face, head, and throat rich dark chocolate brown, with golden-brown wash in front of ears; ears and patch under each ear dusky; occiput and neck grizzled golden-brown; back pale, overlaid by buffy tips; legs and feet varying from blackish brown to brownish black.

Cranial characters.—*Adult male* (type): Skull elongate, narrow; zygomata moderately spreading, outbowed, rounded posteriorly, squamosal part not vertically expanded; frontal shield in same plane with rostrum, narrow, low, flat, or slightly concave, acutely rather short pointed posteriorly, the point entering sagittal crest about one-third the distance from fronto-parietal suture to postorbital process; sagittal crest moderate, reaching more than halfway from occiput to postorbital processes; postorbital processes rather thick, outstanding; fronto-nasal region elevated (not dished); rostrum high and sloping gently upward in plane of frontals; lachrymal opening within orbit; palate long and narrow; postpalatal shelf long; postpalatal notch long and narrow; occipito-sphenoid short, about 80 mm.; basisphenoid deeply concave, without trace of median ridge. Underjaw long. Teeth moderate; canines rather long; $PM_{\overline{4}}$ with moderately sloping heel slightly upturned at tip, sulcus very shallow; $M_{\overline{1}}$ rather short, with cusplet on inner side of saddle posteriorly; $M_{\overline{2}}$ with anterior moiety decidedly longer than posterior and twin cusps of entoconid small and not deeply notched; $PM^{\underline{4}}$ large and rather broad; $M^{\underline{1}}$ broad and rather short; $M^{\underline{2}}$ broad in anterior half, then narrowing strongly, the heel obliquely truncate on outer side; cusps rather weak.

Adult female: Similar, but, much smaller, distinctly dished, point of shield lyrate, zygomata more angular.

Cranial comparisons.—Adult male (type) compared with adult *orgilos* (type): Size essentially same; vault of cranium higher; rostrum and fronto-nasal region longer and more elevated; postorbital processes heavier and shorter; occipito-sphenoid much shorter (80 mm. contrasted with 90); mandible more massive. Canines larger and longer; $M_{\overline{1}}$ shorter; $M^{\underline{1}}$ and $M^{\underline{2}}$ shorter and broader ($M^{\underline{2}}$ broader in middle.)

Remarks.—*Ursus eltonclarki* falls in the *tahltanicus* group. Oddly enough, it resembles *mirus*, a geographically remote member of the group from the Yellowstone Park country, much more closely than it does *tahltanicus*. It agrees with *mirus* essentially in narrowness of skull as a whole, elevation and narrowness of rostrum and narrowness of palate, and even exceeds *mirus* in narrowness of shield and postpalatal notch. Even the underjaw agrees surprisingly with that of *mirus*, and the molar series are of approximately the same length, but the lower canines are materially larger.

Skull measurements.—Adult male (type): Basal length, 316; occipito-nasal length, 322; palatal length, 173; zygomatic breadth, 215; interorbital breadth, 69.

URSUS TAHLTANICUS MERRIAM.

TAHLTAN GRIZZLY.

Ursus tahltanicus Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 181–182, August 13, 1914.

Type locality.—Klappan Creek (=Third South Fork Stikine River), British Columbia.

Type specimen.—No. 179928, ♂ old, U. S. National Museum, Biological Survey collection. Collected in September, 1906, and presented by G. Frederick Norton.

Range.—Middle and upper Stikine-Skeena region, limits uncertain.

Characters.—Size medium; skull of male slightly smaller than male *stikeenensis* and *canadensis;* skull of female about same size as female *stikeenensis*, decidedly larger than female *canadensis*. Color of type very dark.

Color.—*Type specimen:* Black (head absent, but entire body and legs almost coal black, lightly grizzled on shoulders and anterior part of back by tips of golden brownish).

Cranial characters.—*Adult and old males:* Rostrum rather narrow (in old age compressed in front of orbits); vault of cranium low, flattish; frontal shield of moderate breadth, flat or depressed (sometimes sulcate medially), rather short pointed, sloping gradually to plane of muzzle, and only slightly dished in fronto-nasal region; postorbital processes peglike, horizontally far outstanding; sagittal crest low, reaching forward a little more than halfway from inion to postorbitals; zygomata broadly spreading and bowed; palate of medium breadth; postpalatal shelf broad and flat; underjaw short—much shorter than in *stikeenensis*, *shoshone*, and *canadensis*—its ramus bellied and upcurved posteriorly, not flattened. Teeth rather small; canines and molars much smaller than in *stikeenensis*.

Female: Skull relatively large (about same length as female *stikeenensis* but much narrower); much larger than female *shoshone* and *canadensis;* vault of cranium moderately elevated, with tendency to a fronto-parietal hump; facial part of skull large and long; frontal shield long, rather narrow, lyre shaped posteriorly, meeting sagittal crest some distance posterior to fronto-parietal suture; fronto-nasal region well dished; palate and postpalatal shelf long; zygomata moderately spreading and conspicuously outbowed; underjaw long. *Young females* are best told by the teeth, especially the lower canines. In *tahltanicus* the lower canines are shorter and more slender than those of *stikeenensis*. In the latter species they are longer and thicker, especially thick in middle.

Cranial comparisons.—Old male (type) compared with adult male *orgilos* (type): Size essentially same (basal length slightly less); top of skull higher; frontal shield broader and less flat; postorbital processes less slender; palate and postpalatal shelf shorter; zygomata less bowed but more widely outstanding; underjaw shorter, much more massive; inferior border of ramus shorter and more bellied posteriorly; coronoid blade more recurved.

Adult male compared with adult male *stikeenensis* (both inhabiting the same region): Basal length, zygomatic breadth, and frontal breadth essentially the same, but frontal region much lower, frontal shield not rising abruptly at orbits, but sloping gently in plane of rostrum; rostrum narrower, higher, and less nearly horizontal (appearing longer); postorbitals much smaller and more horizontally outstanding; palate shorter; underjaw shorter. Dentition lighter.

Skull measurements.—Old male (type): Basal length, 305;[1] occipito-nasal length, 304; palatal length, 163; zygomatic breadth, 220; interorbital breadth, 84.

URSUS INSULARIS MERRIAM.

ISLAND GRIZZLY.

Ursus eltonclarki insularis Merriam, Proc. Biol. Soc. Washington, XXIX, p. 141, September 6, 1916.

Type locality.—Admiralty Island, Alaska.

Type specimen.—No. 205186, ♂ old, U. S. National Museum, Biological Survey collection, 1914. Purchased from W. H. Case, of Juneau.

Characters.—An island grizzly, apparently related to *tahltanicus* and *orgilos* of the mainland, and to *eltonclarki* of Baranof and Chichagof Islands; in some respects a miniature of *hoots*. $PM_{\overline{4}}$ indistinctly of grizzly type. External characters unknown.

Cranial characters.—*Adult male* (type): Size medium; frontal shield broad and flattish, with *exceptionally large, broad, and flat postorbitals;* zygomata broadly outstanding; ramus of underjaw strongly upturned posteriorly, elevating coronoid and condyle. Teeth of medium size.

Cranial comparisons.—Adult male (type) compared with old male *tahltanicus* (type): Basal length, zygomatic breadth, breadth and form of frontal shield, breadth across postorbitals, truncation of nasals, and length of jaw essentially same, but postorbitals very much larger, especially broader and more decurved; fronto-nasal region more dished; rostrum slightly longer; palate, postpalatal shelf, and postpalatal notch narrower; underjaw more massive and more upturned posteriorly; ramus longer; coronoid much higher; subangular border shorter. Molar series of approximately same length but more massive; M^1 longer, M^2 shorter.

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[1] Restored.

Adult male (type) compared with adult male *eltonclarki* (type): Similar in general, agreeing essentially in basilar length, zygomatic breadth, length and narrowness of palate and postpalatal shelf, and narrowness of postpalatal notch, but differing widely in other characters. Vault of cranium less highly arched; frontal shield and postorbitals very much broader and more massive (shield interorbitally 82 mm. contrasted with 69), less flat, faintly sulcate medially; postorbital processes very much larger, broader, more widely outstanding (from tip to tip 120 mm. contrasted with 101) and more decurved; rostrum lower, broader, and shorter; nasals shorter (89 contrasted with 105—probably not constant). Underjaw more massive; inferior border of ramus longer, more swollen and more upcurved posteriorly; outer side of ramus not depressed or excavated below anterior base of coronoid; coronoid blade narrower and higher. Canines (both upper and lower) somewhat shorter; molars, especially M^1, $M_{\overline{1}}$, and $M_{\overline{2}}$ decidedly larger.

Compared with *orgilos* and *tahltanicus* of the mainland: Easily distinguished by great size of postorbitals and upturning of posterior part of ramus.

Compared with *kwakiutl:* Quickly told by general shortness of skull, including palate and underjaw, and by large size and breadth of postorbitals.

Skull measurements.—Old male (type): Basal length, 311; occipito-nasal length, 310; palatal length, 171; zygomatic breadth, 216; interorbital breadth, 82.

URSUS ORGILOS MERRIAM.

GLACIER BAY GRIZZLY.

Ursus orgilos Merriam, Proc. Biol. Soc. Washington, XXVII, p. 176, August 18, 1914.

Type locality.—Bartlett Bay, east side of Glacier Bay, Southeastern Alaska.

Type specimen.—No. 180280, probably ♂, rather old, U. S. National Museum, Biological Survey collection. Collected August 22, 1912, by A. Hasselborg.

Cranial characters.—Size medium; skull long, rather narrow, low, flat on top, slightly dished. Frontal shield rather narrow, flat, concave between orbits, acute pointed posteriorly; postorbital processes long, slender, outstanding, slightly decurved and recurved (posteriorly);

rostrum normal or rather small; nasals nearly horizontal, slightly uplifted and decurved anteriorly; braincase long and low; squamosal shelves long; zygomata moderately spreading and strongly outbowed, the broadest part more anterior than usual; sagittal crest straight and nearly horizontal, reaching only to fronto-parietal suture; palate long and rather narrow; postpalatal shelf long, flat, and rather broad for size of skull; jugal broad anteriorly, rising well above lachrymal duct; lachrymal duct opening within orbit; occipito-sphenoid long (90 mm.); underjaw long; coronoid blade broad at base, moderately high, the apex moderately recurved. Teeth of medium or rather small size.

Cranial comparisons.—*Ursus orgilos* needs to be distinguished from its neighbors, *orgiloides*, *tahltanicus*, and *pallasi*. Compared with *orgiloides*, with which it agrees essentially in size of skull and length of braincase: Shield narrower, gently sloping instead of rising strongly from rostrum; rostrum longer and narrower; palate narrower. Compared with *tahltanicus:* Skull and shield narrower; postorbitals more slender and delicate; zygomata much less outstanding; underjaw more slender and delicate. Compared with *pallasi:* Skull as a whole, braincase, and posterior part of frontal shield much longer; shield less elevated above rostrum; sagittal crest shorter.

Skull measurements—Probably old male (type): Basal length, 316; occipito-nasal length, 304; palatal length, 177; zygomatic breadth, 207; interorbital breadth, 75.

URSUS ORGILOIDES SP. NOV.

ALSEK GRIZZLY.

Type No. 223275, probably ♂, U. S. National Museum, Biological Survey collection. From Italio River, Alaska. Collected November, 1916. Purchased from E. M. Axelson, of Yakutat.

Range.—Coast strip southeast of Yakutat Bay. Specimens have been received from near Yakutat village and from Ankow and Anklin Rivers and mouths of Alsek and Italio Rivers.

Cranial characters.—Skull of medium size, long, low, and smoothly rounded, rather narrow, with long braincase, long-pointed shield, rather short rostrum, and large broadly rounded lambdoid crest; shield medium, *rising strongly from horizontal rostrum*, sulcate interorbitally and swollen between sulcus and orbits; point ending at or near fronto-parietal suture; postorbital processes moderate, somewhat decurved; sagittal crest rather short; occipital overhang and inion well developed; rostrum short, broad for size of skull; nares truncate; zygomata not widely outstanding and not bowed; palate long, of moderate breadth; mastoids appressed; meatus tube large and free; underjaw long; coronoid blade moderate; apex only slightly recurved. Teeth rather small.

Cranial comparisons.—Adult male (type) compared with the type of *orgilos:* Size, length of braincase, and length of postorbital part of frontal shield essentially same; shield broader, *rising strongly from rostrum instead of sloping gradually into rostrum*, sulcate anteriorly and swollen between sulcus and orbits; rostrum shorter and broader; lachrymal duct opening on orbital rim instead of within rim; zygomatic arches more subtriangular (less bowed); palate broader; meatus tube much larger; lambdoid crest more highly developed and more broadly rounded. Teeth about same size; $PM_{\overline{4}}$ distinctly of grizzly type (in *orgilos* subconical).

Compared with the type of *pallasi*, which it strongly resembles: Length about an inch greater (mainly in posterior part of skull); braincase and point of shield much longer; sagittal crest much shorter; occipito-sphenoid and palate longer; mastoids appressed instead of divergent; underjaw much longer, but inferior border of ramus of essentially same length; subangular border slightly longer.

Remarks.—Unfortunately there is possible doubt as to the sex of the type specimens of *orgilos* and *orgiloides*, though both are believed to be males. Both skulls have the appearance of males, except that in *orgiloides* the point of shield is longer than usual in males and the canines are small for males of corresponding size.

Skull measurements.—Adult male (type): Basal length, 316.5; occipito-nasal length, 300; palatal length, 169; zygomatic breadth, 218; interorbital breadth, 81.5.

URSUS PALLASI MERRIAM.

PALLAS GRIZZLY.

Ursus pallasi Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 149–150, September 6, 1916.

Type locality.—Donjek River, southwestern Yukon.

Type specimen.—No. 205160, ♂ old, U. S. National Museum, Biological Survey collection. Collected August, 1913, by T. A. Dixon.

Range.—Southwest corner of Yukon Territory, east of the St. Elias Range (Kluane Lake, Donjek River, St. Clair River) and adjacent eastern border of Alaska; easterly to McConnell River and Teslin Lake and south into northern British Columbia.

Cranial characters.—*Old male* (type): Size small, one of the smallest of the grizzlies; skull moderately elevated, flattish on top, with relatively broad frontal shield rising strongly at orbits. Frontal shield flattish, exceedingly short pointed posteriorly, faintly depressed medially between orbits, slightly swollen on sides of median depression, strongly sloping to rostrum; postorbital processes small, peglike, horizontally outstanding; fronto-nasal region strongly dished; rostrum short, somewhat depressed and pugged; nasals rising anteriorly; nares small and subtruncate; sagittal crest long, reaching to halfway between fronto-parietal suture and plane of postorbitals; zygomatic arches moderately outstanding, narrow, and slender, not expanded vertically; palate and postpalatal shelf short and broad; mastoids long and spreading. Underjaw long for size of skull; coronoid narrow above, the apex not reaching plane of condyle; teeth rather large for size of skull.

Old female (No. 205162) from St. Clair River, Yukon; collected September 6, 1914, by A. Hoyt: Size very small; frontal shield remarkably broad for so small a skull, convex and medially sulcate interorbitally; fronto-nasal region strongly dished; postorbitals small, outstanding; rostrum short and depressed; palate and postpalatal shelf short and broad; zygomata rather strongly outstanding, subtriangular. Underjaw very small and light; coronoid moderate, apex strongly recurved; teeth very small, nearly as small as in *nelsoni*.

Cranial comparisons.—Ursus pallasi, owing to the number of species occurring in or adjacent to its range, should be known from *tahltanicus*, *orgilos*, *orgiloides*, *pulchellus*, and *kluane*. It may be related to *tahltanicus* but is easily distinguished by its low broad rostrum, strongly dished fronto-nasal region, very short shield, less elevated midfrontal region, long and rather high sagittal crest, and larger teeth; while *tahltanicus* has a higher and narrower rostrum, sloping fronto-nasal region, much longer shield, higher midfrontal region, shorter and lower sagittal crest, and smaller teeth. From *orgilos* and *orgiloides* it may be told by the shortness of the skull as a whole, shortness of braincase and point of frontal shield, and greater length of sagittal crest. From *pulchellus* it differs in lower vault of cranium, much broader shield and rostrum, shorter rostrum, broader palate and postpalatal shelf, longer underjaw, and smaller molars. From *kluane* it differs strikingly in much smaller size, much lower arch of cranium, conspicuously shorter braincase and sagittal crest; very much smaller, narrower, and less strongly decurved postorbitals; very much less elevated and more dished fronto-nasal region; much lower rostrum; much shorter palate and much shorter underjaw.

Adult female compared with adult female *kluane:* Size of skull essentially same or slightly smaller; canines smaller; *molars very much smaller.*

Skull measurements.—Old male (type): Basal length, 302.5; occipito-nasal length, 279; palatal length, 159; zygomatic breadth, 209; interorbital breadth, 72.5.

URSUS RUNGIUSI RUNGIUSI[1] SP. NOV.

RUNGIUS GRIZZLY.

Type No. 179893, ♂ young-adult, U. S. National Museum, Biological Survey collection. Collected September, 1910, in Rocky Mountains on headwaters of Athabaska River, Alberta, by Carl Rungius, and by him presented to the Biological Survey.

Characters.—Young-adult male (type): Size small; skull low and flat, with low depressed braincase, very broad depressed sinus case, medium or narrow and exceptionally short frontal shield, long sagittal crest, and long, peglike outstanding postorbital processes. *Fully adult males* differ somewhat. An old male from Fortress Lake, head of Athabaska River (No. 40091, Amer. Mus. Nat. Hist.), killed in May, 1916, by Malcolm S. Mackay; another old male (No. 1919, Ottawa Museum) from Kootenay Pass, Alberta; and a fully adult male (No. 209899) from Indian Point Creek, near Barkerville, B. C., present the following characters: Skull small, low, and nearly flat; shield low, of medium breadth, broadly flat-concave between orbits, sloping gradually into rostrum, very short pointed posteriorly; postorbitals peglike, outstanding, and elevated; orbital rims slightly thickened and everted; rostrum small, narrow, and rather high for so small a skull; zygomata widely outbowed; palate and postpalatal shelf narrow; base of cranium rather narrow; mastoids appressed (not outstanding); underjaw rather light; apex of coronoid recurved. Dentition moderate. $PM_{\overline{4}}$ distinctly of grizzly type. Canines and upper molars rather large for so small a skull.

Cranial comparisons.—Adult male (No. 209899), from Indian Point Creek, B. C., compared with adult male *macfarlani* (type): Size slightly less; skull as a whole much lighter; rostrum much smaller and less elevated; fronto-nasal region slightly dished; zygomata much less widely outbowed; palate and postpalatal shelf much narrower; sagittal crest shorter; base of skull narrower; underjaw much less massive; apex of coronoid more recurved. Dentition lighter (except M^2, which is of about same size in both); $M_{\overline{1}}$ less swollen; $PM_{\overline{4}}$ distinctly of grizzly type (not conical as in *macfarlani*).

Adult male (No. 209899, from Indian Point Creek, B. C.) compared with adult male *ophrus* (type): Size smaller; vault of cranium very much lower and flatter; frontal shield broadly concave, not deeply sulcate medially; postorbital processes more slender and horizontal; orbital rims slightly or not swollen; fronto-nasal region not notably dished; rostrum lower; nares smaller; sagittal crest less highly developed and straighter (less convex); zygomata very much less outbowed and only slightly arched (in *ophrus* very highly arched) mastoids much shorter; underjaw much shorter; coronoid about the same size; upper canines and upper and lower molars about the same size; lower canines smaller.

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[1] Named for the artist, Carl Rungius, of New York, who collected and presented the type specimen.

Adult and old males compared with old male *hylodromus* (No. 205170), from Selkirk Mountains, B. C.: Skull shorter; shield flat-concave, rising at orbits and postorbitals (in *hylodromus* decurved laterally); posterior part of shield very much shorter; vault of cranium much lower; braincase more depressed; rostrum smaller, narrower, more nearly horizontal; zygomata more outbowed (less triangular); sagittal crest longer; postpalatal shelf narrower.

Skull measurements.—Young-adult male (type): Basal length, 293; occipito-nasal length, 282; palatal length, 162; zygomatic breadth, 190; interorbital breadth, 73. Adult male (No. 209899) from Indian Point Creek, B. C.: Basal length, 294;[1] occipito-nasal length, 278.5; palatal length, 161; zygomatic breadth, 198; interorbital breadth, 75. Old male (No. 40091 Amer. Mus. Nat. Hist.) from head Athabaska River, B. C.: Basal length, 295; occipito-nasal length, 276; palatal length, 166; zygomatic breadth, 214; interorbital breadth, 75.

URSUS RUNGIUSI SAGITTALIS SUBSP. NOV.

CRESTED GRIZZLY.

Type No. 210705, ♂ ad. (rather old), U. S. National Museum, Biological Survey collection. From Champagne Landing, southwestern Yukon. Collected in the fall of 1915. Purchased from Mackay & Dippie.

Cranial characters.—*Adult male* (type): Size small; skull low and narrow; shield flat or flat-concave, narrow, short pointed, sloping gradually into rostrum; postorbitals slender, outstanding; rostrum slender; nares large and oblique; zygomata moderately outstanding, subtriangular; sagittal crest long, high, and arcuate; palate narrow; underjaw long and slender; coronoid small and falcate; subangular border short. Dentition moderate.

Cranial comparisons.—Adult male (type) compared with adult male *rungiusi* (No. 209899): Skull similar in general but shield narrower and flatter; postorbitals more slender; orbital rims not thickened or everted; *nares larger and more oblique; sagittal crest very*

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[1] Restored.

much higher, rising well above point of shield; squamoso-jugal suture much shorter; underjaw longer; coronoid smaller and more falcate; subangular border shorter. Canines slightly larger; M^2 somewhat smaller.

Adult male (type) compared with *orgilos* (type): Skull about an inch shorter; braincase very much shorter; point of shield much shorter; sagittal crest longer, much higher, and arcuate instead of straight; rostrum much smaller; squamosal arm of zygoma much shorter; underjaw and ramus much shorter; subangular border nearly the same; coronoid blade narrower.

Skull measurements.—Adult male, old: Basal length, 295;[1] occipito-nasal length, 281; palatal length, 160; zygomatic breadth, 200; interorbital breadth, 71.5.

URSUS MACFARLANI[2] SP. NOV.

MacFarlane Bear.

Type No. 6551, ♂ ad., U. S. National Museum. Collected on Anderson River, 50 miles below Fort Anderson, Mackenzie, May 8, 1863, by R. MacFarlane. (Original No. 551.)

Characters.—External characters unknown. Relationship apparently with *rungiusi*.

Cranial characters.—Size medium; skull of adult male (type) massive, low, broad, flat; tip of nose to point of shield in same plane without trace of dishing. Frontal shield low, flat-concave, rather broad, exceptionally short posteriorly, shallowly concave between orbits, not rising above plane of rostrum; postorbitals large, horizontally outstanding and slightly elevated; rostrum broad and high, large for size of skull; zygomata widely outbowed; sagittal crest long and low; palate and postpalatal shelf broad; underjaw massive, coronoid blade high, narrow, nearly vertical, obtusely rounded above; subangular border exceptionally short. Dentition heavy: Canines and molars large for size of skull; $PM_{\overline{4}}$ subconical; $M_{\overline{1}}$ swollen; M^1 moderate, the heel slightly emarginate and rather broadly rounded posteriorly. In immature and young-adult males the frontal shield is less flat, the sides (between sulcus and orbits) strongly swollen (as shown by No. 7146, from Franklin Bay; and 2773, Ottawa Museum, from Stapylton Bay).

Cranial comparisons.—Adult male (type) compared with adult male *rungiusi* (No. 209899) from Indian Point Creek near Barkerville, B. C.: Skull slightly larger and *much more massive*, with higher and much broader rostrum, and much more widely outbowed zygomata; sagittal crest longer; palate, postpalatal shelf, and base of skull much broader; underjaw much more massive; coronoid blade more nearly vertical and less recurved at apex. Dentition heavier: Canines and molars, upper and lower, larger; $M_{\overline{1}}$ more swollen; $PM_{\overline{4}}$ subconical (not at all of grizzly type).

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[1] Partly restored.

[2] Named in honor of Roderick MacFarlane, who collected the specimen and presented it to the Smithsonian Institution.

Skull measurements.—Adult male (type): Basal length, 303; occipito-nasal length, 283; palatal length, 164; zygomatic breadth, 218; interorbital breadth, 79.

URSUS CANADENSIS MERRIAM.[1]

CANADA GRIZZLY.

Ursus shoshone canadensis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 184–185, August 13, 1914.

Type locality.—Moose Pass, near Mount Robson, British Columbia.

Type specimen.—No. 174511, ♂ ad., U. S. National Museum. Collected by N. Hollister and Charles D. Walcott, jr., July 23, 1911. (Original No. 3792, Hollister catalogue.)

Range.—Eastern British Columbia; limits unknown (type from near Mount Robson; and an adult female from Kootenay Lake).

Characters.—Size medium; color brown, grizzled with buff; claws short for a grizzly, rather thick, moderately curved, pale yellowish on upper surface and tips, brownish horn color on sides.

Color.—Muzzle very pale drab brown, changing to darker brown on head, face, and chin, darkest around ears; top of head, cheeks posteriorly,[2] ears, back, and thighs washed with buffy whitish from abundance of buffy-tipped hairs; foreleg and lower part of hind leg and feet very dark (almost blackish brown); long hairs of throat and axillary region pale yellowish, of rest of underparts dark brown.

Cranial characters.—*Adult male* (type): Skull of medium size, rather long, low, and narrow, flat in frontal region, with long, high sagittal crest rising above general level of top of cranium. Frontal shield small, flat, narrow, faintly depressed medially, short pointed posteriorly, gently sloping; postorbitals slender, peglike, horizontally outstanding; rostrum relatively high, tapering anteriorly; sagittal crest remarkably long, arcuate, and high, reaching nearly to midway between fronto-parietal suture and plane of postorbitals; zygomata moderate, slightly outbowed, and only slightly expanded vertically; palate excavated between molar series; postpalatal shelf rather long and broad; notch medium or narrow. Underjaw rather massive;

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[1] Tentatively included in *planiceps* group. (See Introduction, pp. 12–13.)

[2] The old whitish-tipped hairs of the old coat have fallen out on the cheeks and anterior part of head nearly to ears.

ramus moderately bellied posteriorly; coronoid blade broad and rather short, the apex cutting plane of condyle. Dentition rather heavy; canines thick and short; molars broad.

Adult female (No. 209902 from Kootenay Lake, British Columbia): Skull rather small, long, narrow, low, and slightly dished. Frontal shield *narrow*, flattish, slightly depressed medially between orbits, long pointed, the point reaching to midparietal region; postorbitals moderate; rostrum long and slender, tapering; zygomata moderately spreading. Underjaw similar to that of male but much smaller; coronoid blade relatively narrower and higher. Dentition heavy; teeth similar to those of male and only slightly smaller; canines large and swollen; molars broad.

Cranial comparisons.—Adult male (type) compared with adult male *macrodon* (type): Size essentially same; shield more strongly sloping; postorbitals more slender; rostrum lower and more tapering; sagittal crest higher; inion much more strongly produced; subangular border of ramus shorter; angular process not bellied; canines smaller; M^2 and M_2 decidedly smaller.

Skull measurements.—Adult male (type): Basal length, 313; occipito-nasal length, 312; palatal length, 171; zygomatic breadth, 208; interorbital breadth, 74.

Arizonæ Group.

URSUS ARIZONÆ MERRIAM.

ARIZONA GRIZZLY.

(Pl. XVI.)

Ursus arizonæ Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 135–136, September 6, 1916.

Type locality.—Escudilla Mountains, Apache County, Arizona.

Type specimen.—No. 177332, ♂ ad., U. S. National Museum, Biological Survey collection. Collected September 3, 1911, by C. H. Shinn.

Cranial characters.—Size rather large; skull as a whole rather long and narrow, with broad rostrum; vault of cranium moderately elevated but not arched, highest about two-thirds distance from plane of postorbitals to fronto-parietal suture; frontal shield rather narrow, nearly flat, gently sloping in plane of rostrum, the posterior point in type specimen reaching to about 25 mm. in front of parietals (in older specimens shorter); postorbitals broad and broadly rounded, nearly horizontal, but not widely projecting; fronto-nasal region and rostrum elevated and swollen, continuing plane of frontal shield without trace of dishing, tapering anteriorly; zygomata not widely outstanding, bowed, anterior roots swollen; palate rather short and broad; postpalatal shelf broad; meatus tube long; coronoid blade rather broad above, its recurved apex cutting plane of condyles. Teeth rather small for size of skull; canines of good size; molars rather small for size of skull, especially last upper molar.

Cranial comparisons.—Adult male (type) compared with old male *apache* (type): Basilar length, occipito-nasal length, length of palate, interorbital breadth, and occipito-sphenoid length essentially the same; zygomata very much less outstanding and subtriangular instead of bowed; frontal shield flatter, of essentially the same breadth interorbitally, but very much narrower across postorbital processes; postorbital processes much less broadly outstanding; orbital rims less swollen; fronto-nasal region much more elevated and swollen; rostrum much larger, broader, more swollen, and tapering instead of depressed basally, narrow, and horizontal; palate and postpalatal shelf much broader. Underjaw weaker; ramus less broad vertically; coronoid blade less high; molars slightly larger; heel of M^2 longer, more distinctly emarginate on outer side (less tapering).

Skull measurements.—Adult male (type): Basal length, 326; occipito-nasal length, 323; palatal length, 175; zygomatic breadth, 208; interorbital breadth, 82.

URSUS IDAHOENSIS SP. NOV.

IDAHO GRIZZLY.

Type No. 93, ♂ old, Merriam collection (=187888 U. S. National Museum), from North Fork Teton River, eastern Idaho, September 23, 1874. Killed by the late Richard Leigh (better known as "Beaver Dick").

Characters.—Size rather large, about equaling *arizonæ* (much smaller than *horribilis* and subspecies, and shorter than *rogersi*, *bisonophagus*, and *perturbans*); frontal shield convex both longitudinally and transversely; fronto-nasal region elevated and somewhat compressed (much as in *rogersi*, but rostrum much shorter); postorbital processes rather weak and decurved as in *rogersi* and *arizonæ;* sagittal crest rather short and not strongly developed; zygomata moderately outbowed; coronoid blade rather high, but less high than in *bisonophagus* and *rogersi;* ramus flattish, broad vertically, but much less broad and massive then in *rogersi;* dentition rather heavy; M^2 large, its heel elongate, emarginate, but not narrowed posteriorly, slightly everted; canines rather small, about as in *rogersi* and *arizonæ.*

An old female (No. 160153) from Wallowa Mountains, Oregon, is assumed to be typical of *idahoensis.* It has a long, low, slender, smoothly rounded skull with narrow zygomatic arches, narrow palate, rather broad postpalatal shelf, and very small teeth.

Skull measurements.—Old male (type): Basal length, 317; occipito-nasal length, 318; palatal length, 177; zygomatic breadth, 206; interorbital breadth, 81.

URSUS PULCHELLUS PULCHELLUS SP. NOV.

UPPER YUKON GRIZZLY.

Type No. 221599, ♂ ad., U. S. National Museum, Biological Survey collection, from Ross River, Yukon Territory, Canada. Collected July 20, 1916, by Fred E. Enevoldsen.

Characters.—Size small; frontal shield and rostrum narrow; vault of cranium well arched; base of cranium moderately arched; shield rising rather strongly from plane of rostrum, convex transversely but shallowly sulcate medially, short pointed posteriorly (point ending about halfway between plane of postorbitals and fronto-parietal suture); rostrum slender and high; fronto-nasal region dished; nasals nearly horizontal; sagittal crest only slightly developed, not high posteriorly, somewhat decurved; occiput rather low and shortly truncate; palate and postpalatal shelf rather narrow; zygomata subtriangular; squamosal root expanded vertically; occipito-sphenoid short (80 mm.); underjaw short, its inferior border straight; coronoid rather low, broad basally, apex strongly recurved; subangular border short. Teeth, particularly molars, large for so small a skull; last upper molar broadly quadrate anteriorly, the heel abruptly and strongly emarginate, narrowly rounded posteriorly; M^1 large, broad, and massive.

Cranial comparisons.—*Ursus pulchellus* requires comparison with its near relative *ereunetes*, and also with *pallasi* and *kluane*. Adult male (type) compared with adult male *ereunetes* (type): Size slightly smaller; fronto-nasal region more dished; shield less flat; zygomata broad (in *ereunetes* slender); occipito-sphenoid shorter; M^1 larger and more massive.

Compared with old male *pallasi* (type): Basal length slightly less; occipito-nasal length same; zygomatic breadth less; cranium higher and more arched; frontal shield and rostrum conspicuously narrower; palate and postpalatal shelf narrower; rostrum longer, higher, and more slender; squamosal root of zygoma more broadly expanded vertically; mastoids less elongate; underjaw shorter and less massive. Upper molars larger and more massive.

Compared with adult male *kluane:* Similar in general appearance but skull as a whole, braincase, palate, and underjaw *very much shorter;* frontal shield *very much narrower;* inferior border of ramus more abruptly upcurved; subangular border more nearly horizontal and much more sharply defined.

Remarks.—The type of *pulchellus* came from Ross River, a northern tributary of the Pelly. Skulls of males from the southwestern corner of Yukon (Donjek River and Champagne Landing) differ in greater occipito-nasal length, more highly arched cranium, more elevated rostrum, and less deeply emarginate heel of M^2.

I refer to *pulchellus* an adult female, No. 204187, from McConnell River, Yukon, and a still older female, No. 215113, from Ross Mountains.

Skull measurements.—Adult male (type): Basal length, 292; occipito-nasal length, 281; palatal length, 160; zygomatic breadth, 196; interorbital breadth, 66.

URSUS PULCHELLUS EREUNETES SUBSP. NOV.

KOOTENAY GRIZZLY.

Type No. 222323, ♂ ad., from Beaverfoot Range, Kootenay District, British Columbia. Collected October 1, 1916, by George Hill, of Field, British Columbia.

Characters.—Size rather small; occiput shortly truncate; vault of cranium and basicranial axis well arched; fronto-nasal region elevated, sloping gradually upward, not dished; rostrum small, rather narrow, rising gradually into shield; point of shield ending about two-thirds distance from plane of postorbitals to fronto-parietal suture; zygomata slender, rather broadly outbowed for size of skull. Last upper molar broad anteriorly, the anterior part of cingulum on inner side produced, the heel emarginate, narrowing posteriorly, subtriangular; middle lower molar large and massive.

Skull in general similar to that of *pulchellus* but slightly larger, with more elevated fronto-nasal region, flatter shield, much more slender zygomata, and much longer occipito-sphenoid; teeth as in *pulchellus* except that M^1 is smaller, and $M_{\overline{2}}$ is less quadrangular anteriorly.

Skull measurements.—Adult male (type): Basal length, 297; occipito-nasal length, 278; palatal length, 165; zygomatic breadth, 203; interorbital breadth, 72.

URSUS ORIBASUS SP. NOV.

LIARD RIVER GRIZZLY.

Type No. 223991, ♂ ad. (rather old), U. S. National Museum, Biological Survey collection. From Upper Liard River, Yukon, near British Columbia boundary. Killed by J. Thompson in the spring of 1916. (Purchased from William Drury, of Whitehorse.)

Characters.—*Adult male* (type): Size large; hump absent or inconspicuous; color dark; claws long (longest 90 mm.[1]) and unusually straight; top convex in section, dark horn color, paler at tips and along upper surface; skull long, narrow, and arched, with elevated straight-sloping fronto-nasal region (much like that of *ereunetes* but much longer posteriorly). Frontal shield, rostrum, and molar teeth narrower than in any other member of the *shoshone* group.

Color.—General ground color dark brown to dusky; muzzle dull golden brown, becoming much darker between eyes; a dark ring around each eye; cheeks chestnut brown; top of head, nape, and shoulders strongly washed with yellowish buffy; back washed with soiled buffy; rump dark brownish dusky; legs and feet dusky blackish.

Cranial characters.—Adult male (type): Skull rather large, long, narrow, rather strongly arched both above and below, with high straight-sloping (not dished) fronto-nasal region. Frontal shield narrow, flat, gently sloping, the point reaching two-thirds distance from postorbitals to parietals; postorbitals rather small, horizontally outstanding; rostrum narrow and high, in same plane with frontal shield; braincase and sagittal crest long; inion and occipital overhang marked; zygomata well outstanding, strongly subtriangular, squamosal base broadly expanded; basicranium and palate arched; palate and postpalatal shelf narrow; occipito-sphenoid 92 mm.; mastoids large, divergent. Underjaw long; ramus long and flat; subangular border short and broad; coronoid blade narrow. Canines rather long; molars narrow and rather small; $M^{\underline{2}}$ small, narrowly triangular, the heel small, thin, and pointed; $PM_{\overline{4}}$ imperfectly of grizzly type.

Cranial comparisons.—Old male (type) compared with old male *chelan* and *idahoensis* (both types): Length, height, and arching essentially same; shield narrower, flatter, and more nearly horizontal; sinus case and rostrum narrower; top of rostrum higher and more completely in fronto-nasal plane; zygomatic arches shorter and more angular (less outbowed), the inclosed space (temporal fossa) much smaller. Underjaw shorter and weaker; subangular border shorter; coronoid blade narrower.

Old male (type) compared with adult male *ereunetes* (type): Similar in general appearance but *length much greater;* shield flatter; rostrum more elevated; braincase much longer; sagittal crest much longer and higher; inion more strongly produced; squamosal base of zygoma broadly expanded (in *ereunetes* not expanded). Canines longer; molars smaller and *very much narrower.*

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[1] Claw of second or index finger longest, but second, third, and fourth practically subequal; claw of thumb very long. Claw measurements of right hand (those of left hand more worn at tips) from upper exposed base to tip: First, 82 mm.; second, 90; third, 88; fourth, 89; fifth, 68.

Remarks.—*Ursus oribasus* appears to be closely related to *pulchellus* and *ereunetes*, both of which have decidedly smaller skulls with larger teeth. It is related also to *idahoensis* and *chelan*, which are about the same size, but have much broader skulls and differ otherwise as already pointed out.

Skull measurements.—Adult male (type): Basal length, 310; occipito-nasal length, 304; palatal length, 172; zygomatic breadth, 215; interorbital breadth, 75.

URSUS CHELAN Merriam.

Chelan Grizzly.

Ursus chelan Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 136–137, September 6, 1916.

Type locality.—East slope Cascade Mountains, northern Chelan County, Washington.

Type specimen.—No. 205185, ♂ old, U. S. National Museum, Biological Survey collection. Killed in Township 30 N, Range 16 East, Willamette Meridian, Wenatchee National Forest. Collected September 1, 1913, by D. S. Rice.

Range.—Cascade and Cassiar Mountains from northern Washington to upper Stikine River and Dease Lake, British Columbia.

Cranial characters.—(External characters unknown). Skull of medium or rather large size; facial axis strongly deflected from basicranial axis; vault of cranium well arched, highest over posterior frontal region; sagittal crest long, high, arcuate, rising anteriorly above general level of top of cranium. Affinities apparently with *hylodromus* on the one hand, and with *shoshone* and *pervagor* on the other. Frontal shield narrow, flattened, short pointed posteriorly, ending about midway between fronto-parietal suture and plane of postorbitals, slightly sulcate medially; postorbital processes rather broad, flat, outstanding horizontally (not depressed or decurved); fronto-nasal region including posterior two-thirds of nasals sloping strongly, forming part of long fronto-facial plane; rostrum small, short, somewhat depressed, sloping anteriorly to nares, gradually rising posteriorly into frontal plane; braincase long, arched, frontal part keeled into sagittal crest; palate arched antero-posteriorly, slightly concave; postpalatal shelf broad; zygomata broadly spreading, rounded and outbowed posteriorly, vertically expanded and strongly arched; mastoids of medium length, spreading; underjaw massive; ramus swollen on outer side over roots of $M_{\overline{2}}$ and $M_{\overline{3}}$, bellied under last molars; coronoid blade high, its anterior border rather strongly recurved, the apex overarching high coronoid notch but barely reaching plane of front of condyle; teeth· rather small for size of skull (so badly worn in type specimen that proportions of canines can not be determined).

Cranial comparisons.—Old male *chelan* differs from all its relatives in the degree of deflection of the facial part of the skull, and exceeds all except *hylodromus* in the arching of the palate.

Old male (type) compared with *pervagor* (type): Basal length slightly less; zygomatic breadth greater; frontal shield shorter pointed and flatter; postorbitals flatter and apparently broader; sagittal crest longer, higher anteriorly and more convex; rostrum shorter and more strongly sloping anteriorly; nares more truncate; zygomata more strongly outbowed, more arched, more expanded vertically, squamosal arm longer (squamoso-jugal suture much longer); palate shorter and more strongly arched; underjaw shorter, its inferior ramus much shorter; coronoid blade slightly higher and more falcate. Some of these differences may be due to age, the skull of the type of *chelan* being very old, while the type of *pervagor* is only adult. However, it differs rather conspicuously from equally old male *pervagor* from Bridge River (No. 4, Provincial Museum, Victoria, B. C.) as will be seen from the following: Basal length 20 mm. less; occipito-nasal length slightly greater; zygomatic breadth less; facial part strongly deflected (in *pervagor* not deflected); palate arched (in *pervagor* not arched); frontal shield shallowly sulcate medially (in *pervagor* broadly concave); postorbitals broad, flat, horizontally outstanding (in *pervagor* long, peglike, uplifted, and arched); braincase and sagittal crest arched (in *pervagor* straight and nearly horizontal); occipital overhang much greater; zygomata less widely outbowed.

Old male (type) compared with old male *hylodromus* (No. 205170) from Selkirk Mountains, British Columbia: Size larger (basal length only slightly greater but occipito-sphenoid and occipito-nasal lengths much greater, and skull as a whole distinctly larger); vault of cranium decidedly more highly arched; facial angle more strongly deflected from basicranial axis; zygomata much more widely spreading and outbowed and much more arched; frontal shield rising less abruptly from rostrum, more evenly sloping, rising higher posteriorly, and much shorter pointed; braincase and sagittal crest much longer, the crest higher and convex or arcuate anteriorly; occipital overhang greater; palate more strongly arched (antero-posteriorly); mastoids longer and strongly spreading. Underjaw longer and more massive, more swollen on outer side below middle and posterior molars; its inferior border more bellied posteriorly; coronoid blade very much higher.

Old male (type) compared with old male *washake* (type): Size slightly larger (basal length essentially the same, but upper part of skull much longer); vault of cranium more highly arched; frontal shield continuing to rise posteriorly (instead of flattened) and much shorter pointed; rostrum decidedly broader; postorbital processes not elevated; lachrymal duct within orbit (not cutting rim as seen from front); braincase compressed and keeled anteriorly (in *washake* depressed); sagittal crest much longer and convex instead of straight; squamosal arm of zygoma longer and more broadly expanded vertically; palate concave and arched antero-posteriorly, instead of flat; postpalatal shelf longer and less broadly flattened; occipito-sphenoid longer; mastoids longer and more spreading. Molars smaller.

Skull measurements.—Old male (type): Basal length, 314; occipito-nasal length, 323; palatal length, 170; zygomatic breadth, 225; interorbital breadth, 86.

URSUS SHOSHONE MERRIAM.

SHOSHONE GRIZZLY.

Ursus shoshone Merriam, Proc. Biol. Soc. Washington, XXVII, p. 184, August 13, 1914.

Type locality.—Estes Park, Rocky Mountains of northern Colorado.

Type specimen.—No. 203185, ♂ old, U. S. National Museum, Biological Survey collection.

Range.—Mountains of Colorado and Wyoming.

Characters.—Size medium or rather large, but much smaller than *horribilis* and *bairdi*—skull about same size as *absarokus*, but narrower and widely different. External characters unknown.

Cranial characters.—*Adult male* (type): Skull rather long and high, with flattish, short-pointed, long-sloping frontal shield continuing plane of rostrum to highest point, about midway between postorbitals and fronto-parietal suture; zygomata moderately spreading, outbowed; anterior (frontal) part of braincase keeling into sagittal crest; sagittal crest long and high; lambdoid crest high; postorbital processes peglike, outstanding, rather slender; nasal region slightly dished and sulcate in middle third (nasals dipping toward one another—may be individual); rostrum of moderate breadth, strongly ascending in plane of frontal shield; palate slightly dished between posterior molars; postpalatal shelf broad; postpalatal notch long and narrow; lachrymal duct cutting orbital rim but mainly on inner side. Underjaw rather long; ramus broad vertically, flattish, highest posteriorly; coronoid blade high, rather strongly sloping, the apex cutting plane of condyle. Canines (absent in type but present in other males) slender; molars medium; M^2 large with long heel.

Adult female (No. 203761, from Fort Fred Steele, Wyoming): Skull long, low, and rather slender; frontal shield narrow, long, lyre pointed posteriorly, flat interorbitally; postorbitals slender and outstanding; rostrum slender; sagittal crest short, reaching only halfway from inion to fronto-parietal suture; lambdoid crest moderate; palate dished between posterior molars; postpalatal shelf broad; notch moderate; meatus tube short; ramus flat and light; apex of coronoid produced posteriorly, overhanging deep coronoid notch. Teeth rather small; upper molars relatively large, M^2 with long heel, out-turned posteriorly; lower molars narrow.

Cranial comparisons.—Adult male compared with adult male *horriæus:* Rostrum, nasals, and frontal shield more elevated and much more strongly ascending posteriorly (less flattened and less nearly horizontal); lambdoid much more strongly developed.

Adult male compared with adult male *absarokus:* Frontal shield flat, rising gradually in long continuous slope to highest point, about 25 mm. anterior to fronto-parietal suture (in *absarokus* arched, strongly convex, and rising suddenly to highest point, immediately behind orbits); postorbital processes more slender; fronto-nasal region only slightly dished; rostrum more slender; braincase narrower; breadth across squamosal shelves less.

Remarks.—Skulls from the Wind River and Absaroka Mountains have the last upper molar smaller, the heel less strongly developed.

Skull measurements.—Old male (type): Basal length, 320; occipito-nasal length, 317; palatal length, 166; zygomatic breadth, 208; interorbital breadth, 78.

URSUS KENNERLYI[1] MERRIAM.

SONORA GRIZZLY.

Ursus kennerlyi Merriam, Proc. Biol. Soc. Washington, XXVII, p. 194, August 13, 1914.

Type locality.—Mountains of northeastern Sonora, near Los Nogales, Mexico.

Type specimen.—Skull No. 2086, ♂ old; skin No. 1047, U. S. National Museum. Collected in June, 1855, by Dr. C. B. Kennerly.

Range.—Nothing is known of the range of *kennerlyi* except that the type specimen came from mountains near Nogales, Sonora. Its affinities with *utahensis* suggest that formerly it may have had a disconnected distribution northward in the mountains of central Arizona.

Characters.—Size rather small. *Ursus kennerlyi* is a strongly marked member of the *arizonæ-utahensis* group, most nearly related to *utahensis* but *very much smaller*, although the teeth are about same size. The skull, though that of an old male, agrees in size (length) with that of female *utahensis*.

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[1] Named in honor of Dr. C. B. Kennerly, who collected the type specimen.

Color.—The prevailing color is dull pale brownish yellow with amber tinge. The tips only are of this color, the basal and larger portion being of a dark chestnut-brown, passing into blackish, which extends nearly to yellowish tips, the blackish predominating along median line of back and posteriorly; legs blackish brown slightly tinged with chestnut (Baird).

Cranial characters.—Size rather small; skull long, narrow, and high, but not much arched; rostrum narrow and high, in same plane with shield; fronto-nasal region strongly elevated, making a convexity slightly above otherwise continuous plane of rostrum and frontal shield; rostrum and fronto-nasal region subterete, constricted (but not strongly pinched in) in front of orbits; nares much higher than broad; frontal shield flat, rather short pointed posteriorly, passing into sagittal crest about one-third distance from frontoparietal suture to postorbitals; postorbital processes long, rather slender, outstanding, and slightly decurved; frontal part of braincase elevated; zygomata moderately spreading and outbowed; palate long, somewhat concave; squamosal shelves broad; coronoid broadly falcate; ramus flat and broad vertically. Teeth of medium size (badly worn).

Cranial comparisons.—Old male (type) compared with old male *horriæus* (type): Size essentially the same; vault of cranium higher over posterior frontal region; frontal shield slightly convex (not sulcate or depressed between orbits or elsewhere), longer pointed posteriorly; fronto-nasal region markedly elevated instead of depressed; rostrum much higher posteriorly, rising in same plane with frontal shield and strongly compressed; postorbital processes more slender and less decurved; sagittal crest much shorter; angle of jaw shorter; inferior border of ramus decidedly longer; apex of coronoid more slender. Teeth so badly worn that detailed characters are lost; in size, however, they agree essentially with those of *horriæus* except that the large lower premolar is decidedly smaller.

Skull measurements.—Old male (type): Basal length, 314;[1] occipito-nasal length, 306; palatal length, 165; zygomatic breadth, 205; interorbital breadth, 75.

URSUS UTAHENSIS MERRIAM.

UTAH GRIZZLY.

Ursus utahensis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 193-194, August 13, 1914.

Type locality.—North Fork Salina Creek, 10 or 12 miles southeast of Mayfield, Utah.

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[1] Restored.

Type specimen.—No. 180193, ♂ old, U. S. National Museum, Biological Survey collection. Collected May 22, 1911, by Mart Martenson.

Range.—Southern Wasatch and Pine Valley Mountains; limits unknown.

Characters.—Size large; coloration apparently normal. Skull long, narrow, and high, but not arched; fronto-nasal region high and very narrow—strongly pinched in.

Color.—Skin of head of male killed on Pine Valley Mountain, southwest Utah (obtained from forest ranger, September 24, 1907, by Clarence Birdseye; original No. 989): Muzzle pale brown; face and throat, except pale lip edgings and long hairs of median line of throat, dark brown, becoming grizzled posteriorly; top of head very dark; grizzled posteriorly by brown-tipped hairs.

Cranial characters.—*Adult male* (type, and equally old male from northeast corner Sevier National Forest): Size large; skull very long, high, and exceedingly narrow; zygomata moderately spreading and outbowed; frontal shield narrow, flattened posteriorly, falling away laterally immediately in front of orbits, leaving a high fronto-nasal ridge; short pointed posteriorly; sagittal crest long and high, reaching anteriorly nearly to midway between fronto-parietal suture and plane of postorbital processes; postorbital processes very long, slender, peglike, and horizontally extended; rostrum long, high, rather narrow, and strongly compressed below nasals; palate and postpalatal shelf exceedingly long; postpalatal shelf and notch narrow; interpterygoid fossa exceptionally deep; basisphenoid strongly concave. Underjaw very long, ramus flat and exceedingly broad vertically; coronoid blade high and moderately recurved. Dentition light for so large a skull; canines rather small; upper and lower molariform series medium or rather small; middle lower molar decidedly narrow; M^2 small, the heel narrowed on outer side.

An imperfect skull of an *old male* (No. 167390) from Pine Valley Mountain, southwest Utah, differs from the type in having still smaller teeth both above and below, the molars, fourth premolar, and canines being but little larger than those of the female from the type locality.

Adult female (No. 180207, from type locality): Similar in general to male, but much smaller and somewhat less extreme. Skull long and narrow; frontals and fronto-nasal region essentially the same but sagittal crest shorter; zygomata relatively as well as actually much narrower (much less spreading) and not outbowed; rostrum narrowest anteriorly; molars smaller; canines much smaller.

Cranial comparisons.—Old male (type) compared with adult and old males of *bairdi* (the only neighboring species of approximately same size): Rostrum longer and decidedly narrower; base of rostrum in front of orbits more compressed; postorbital processes longer and more slender; palate longer; postpalatal shelf narrower; interpterygoid canal much deeper; ramus of jaw longer, decidedly broader (vertically), flatter, and much thinner under $M_{\overline{2}}$ and $M_{\overline{3}}$; upper molariform teeth, middle lower molar, and lower canines much smaller.

Skull measurements.—Old male (type): Basal length, 348; occipitonasal length, 337; palatal length, 194; zygomatic breadth, 226; interorbital breadth, 79.

URSUS PERTURBANS sp. nov.

Mount Taylor Grizzly.

Type No. 222102, ♂ old, U. S. National Museum, Biological Survey collection. Collected near Mount Taylor, northern New Mexico, July 9, 1916, by Ed. Anderson.

Characters.—Size very large; skull long and narrow, with narrowly spreading zygomata and exceedingly high sagittal crest; affinities with *utahensis*, *idahoensis*, and more remotely with *arizonæ*. Claws moderate, slightly curved, mainly ivory whitish on top, darker on sides.

Color.—Adult male (type): General ground color dusky; face and head dark brown, becoming dusky around eyes; body dusky, back grizzled with dark golden tips; legs and feet black.

Cranial characters.—Adult male (type): Skull conspicuously long and narrow, the narrowness marked in braincase, frontal shield, rostrum, palate, postpalatal notch, and basicranial axis; postorbital processes moderately outstanding horizontally, frontal shield broadly and shallowly concave, becoming flat in old age, very short posteriorly, the point entering sagittal crest in midfrontal region (less than halfway from postorbital processes to fronto-parietal suture); fronto-nasal region very slightly dished; rostrum narrow and rather high in type specimen (somewhat broader in very old skull from Datil Mountains, No. 140086); frontal part of braincase keeling into crest; underjaw long; coronoid blade high; ramus straight, its inferior border slightly concave under $M_{\overline{1}}$, only slightly upcurved posteriorly, and not broadly expanded vertically; diastema long.

Teeth of medium size, about as in *idahoensis* (much smaller than in *horribilis* and *bairdi*); heel of M^2 long, flat, emarginate, and slightly everted, resembling that of *idahoensis;* $PM_{\overline{4}}$ strikingly small—much smaller than in any other known grizzly and no larger than in some of the black bears (*Euarctos*), its crown falling below plane of molar crowns. Upper canines rather small, as in *idahoensis* and *arizonæ;* lower canines more slender than in these species.

The skull of a still older male (No. 140086) killed some years ago at Kid Springs, Datil Mountains, New Mexico, 10 miles northeast of Datil, and secured for the Biological Survey by N. Hollister, in October, 1905, resembles the type in essential characters, but is even longer and owing to greater age has the frontal shield flatter, the fronto-nasal region less dished, the sagittal crest even more highly developed, the interpterygoid fossa even longer and narrower.

Cranial comparisons.—Old male (type) compared with old male *utahensis* (type): Size and general appearance similar, but underjaw widely dissimilar; nasals and fronto-nasal region less elevated; rostrum smaller; sagittal crest more highly developed; zygomata less spreading; palate and postpalatal shelf shorter; postpalatal shelf less narrowed; underjaw *very much smaller*, shorter, and lighter, the ramus *much less broadly expanded* vertically, its inferior border shorter and less upcurved posteriorly; coronoid blade much smaller and lower. Canines much smaller; molars decidedly larger, especially $M_{\overline{2}}$; heel of M^2 much larger and broader posteriorly.

Remarks.—*Ursus perturbans* appears to have affinities in several directions. In length and slenderness of skull it resembles *utahensis* more closely than any other species, but the underjaw differs amazingly from that of *utahensis*, being relatively small and light, while that of *utahensis* is large and remarkably broad vertically. In dental characters, especially the form of M^2, it resembles *idahoensis*. In the great development of the sagittal crest it exceeds all known grizzlies, not excepting *horribilis*.

Skull measurements.—Old male (type): Basal length, 338; occipito-nasal length, 339; palatal length, 182.5; zygomatic breadth, 210; interorbital breadth, 83.

URSUS ROGERSI ROGERSI[1] SP. NOV.

ROGERS GRIZZLY.

Type No. 222983, ♂ ad., U. S. National Museum, Biological Survey collection. Collected high up on Greybull River, Absaroka Mountains, Wyoming, in the fall of 1890, by Archibald Rogers, and by him presented to the Biological Survey.

Characters.—Skull very large and long, the length of the adult male equalling or slightly exceeding that of *horribilis*, *bairdi*, *utahensis*, and *perturbans;* fronto-nasal region elevated and compressed, forming part of long fronto-nasal plane, as in *bairdi* and *utahensis;* frontal shield rather narrow, faintly convex transversely; postorbitals rather weak and somewhat decurved; sinus case keeling into sagittal crest; rostrum long and rather slender, high posteriorly, strongly sloping; palate narrow and very long; interpterygoid fossa narrow and very long; zygomata moderate, rather low, as in *utahensis* and *idahoensis*—not arched as in *horribilis*, *bairdi*, and *imperator;* underjaw long and massive with ramus rather broadly expanded posteriorly, but very much less so than in *utahensis*. Canines small; molars moderate. Relationships with *arizonæ*, *bisonophagus*, and *idahoensis*, but size much larger; and also with *utahensis*, with which it agrees essentially in size.

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[1] Named for Archibald Rogers, of New York, who collected and presented the type specimen.

Cranial comparisons.—Adult male (type, perhaps not quite fully adult) compared with males of the three related forms, *arizonæ* (type, adult), *bisonophagus* (type, young-adult) and *idahoensis* (type, old): General appearance similar, but skull as a whole, palate, and interpterygoid fossa much longer; underjaw very much longer, larger, and more massive; coronoid blade broader and higher; canines of approximately same length but lower canines more massive basally; molars in general similar, but last upper molar longer, with heel rather broadly rounded posteriorly, instead of emarginate or subtriangular; $M_{\overline{1}}$ smaller; crown of $M_{\overline{3}}$ much longer. More detailed comparisons seem unnecessary, though it may be remarked that from *idahoensis*, its nearest neighbor on the west, it differs markedly not only in greater size, but also in very much longer, larger, and more massive underjaw, and in the following dental characters: M^1 smaller; heel of M^2 broader and not emarginate; $M_{\overline{3}}$ much longer.

Adult male (type) compared with old male *utahensis* (type): Size essentially the same though the basal length is greater; frontal shield somewhat broader; postorbitals less strongly developed, shorter, depressed instead of horizontally outstanding; rostrum larger and less compressed; interpterygoid fossa longer and less deep, palate and postpalatal shelf broader; underjaw of essentially same length, but ramus less broadly flattened. Canines apparently less elongate (in *utahensis* broken); last upper molar larger, the heel broader and more broadly rounded posteriorly; crowns of middle and last lower molars longer.

Skull measurements.—Adult male (type): Basal length, 353; occipito-nasal length, 345; palatal length, 193; zygomatic breadth, 211; interorbital breadth, 86.

URSUS ROGERSI BISONOPHAGUS SUBSP. NOV.

BLACK HILLS GRIZZLY.

Type No. 181089, ♂ young-adult, U. S. National Museum, Biological Survey collection. From Bear Lodge, Sundance National Forest, Black Hills, northeastern Wyoming. Collected in February, 1887, by Paul Kleineidam.

Range.—Black Hills of South Dakota and adjacent northeast corner of Wyoming.

Characters.—Size large; skull long, slender, and rather low, smoothly rounded on sides, with weak decurved postorbitals, and elevated fronto-nasal region. Affinities with *arizonæ* and *rogersi*. Claws of moderate length, strongly curved, smoothly polished, dark horn color, marked toward tips with pale yellowish, and most of them with whitish (superficially) on upper side of basal half.

Color.—*Type:* Muzzle pale brown (apparently old pelage); head and face blackish, becoming slightly grizzled posteriorly and on lower part of cheeks by wash of yellowish-brown-tipped hairs; entire body, legs, and feet very dark brown overlaid on back by wash of light tips.

Cranial characters.—*Young-adult male* (type): Similar in general to *rogersi*. Viewed from *above:* Closely similar except for smaller size and differences in the development of certain parts attributable in the main to lesser age (shield more convex transversely; postorbitals slightly less outstanding; fronto-nasal region slightly higher, almost forming a hump). Viewed from *below:* Palate and postpalatal shelf *very much shorter;* postpalatal notch less narrow; underjaw smaller and lighter; canines longer; M^1 slightly larger; M^2 with heel subtriangular, strongly narrowed on outer side as in *arizonæ* (in *rogersi* not narrowed but rather broadly rounded); $M_{\overline{1}}$ slightly larger; $M_{\overline{3}}$ much smaller. Fully adult skulls would doubtless show other differences.

Cranial comparisons.—Young-adult male (type) compared with adult male *arizonæ* (type): Skull and teeth similar but skull longer and narrower anteriorly; vault of cranium slightly less arched; rostrum narrower; fronto-nasal region slightly more compressed and more elevated, continuing frontal plane; frontal shield slightly narrower, somewhat more convex transversely, its sides more smoothly rounded (doubtless because slightly younger); postorbital processes less developed; lambdoid crest more strongly developed; postpalatal shelf smaller. Underjaw slightly longer; inferior border of ramus longer and more upcurved posteriorly; ramus more broadly expanded vertically; coronoid blade higher and flatter (fossa less deeply excavated), its anterior border more nearly vertical; upper molars somewhat larger; middle lower molars smaller; upper canines essentially the same; lower canines somewhat longer and more slender.

Remarks.—The range of *bisonophagus* appears to be completely isolated from that of its nearest relative *rogersi* of the mountains between Yellowstone Park and Bighorn Basin. On the other hand, its range appears to overlap parts of those of *absarokus*, *horribilis*, and *bairdi*. From *bairdi*, which it resembles in form of skull, it is easily distinguished by decidedly smaller size and very much smaller canines and molars.

Skull measurements.—Young-adult male (type): Basal length, 331;[1] occipito-nasal length, 323; palatal length, 173; zygomatic breadth, 200; interorbital breadth, 80.

URSUS PERVAGOR MERRIAM.

LILLOOET GRIZZLY.

Ursus pervagor Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 186–187, August 13, 1914.

Type locality.—Pemberton Lake (now Lillooet Lake), British Columbia.

Type specimen.—No. 187887, ♂ ad., U. S. National Museum (=No. 6510, Merriam collection). Collected in May, 1883, by John Fannin.

Range.—Interior of southwestern British Columbia; known only from Lillooet Lake and Bridge River.

Characters.—Size rather large. External characters unknown.

Cranial characters.—*Adult male* (type): Size large; skull long, rather narrow, high, moderately dished; zygomata moderately spreading and outbowed; frontal shield of moderate breadth, rather flat, strongly sloping, shallowly sulcate medially, swollen on each side just behind plane of postorbitals; postorbital processes outstanding, thick, peglike; postpalatal shelf rather broad and flat; frontal part of braincase elevated and compressed, supporting posterior part of frontal shield; palate long; squamosal shelf long; mastoids long; interpterygoid fossa short and rather broad; underjaw long; coronoid broad and rather vertical; ramus long, swollen on outer side. Teeth small, particularly the canines and lower molars.

Cranial comparisons.—Adult male (type) compared with adult male *canadensis* (type): Considerably larger; vault of cranium much higher; frontal shield much broader, higher, more strongly sloping, and less flat; frontal part of braincase elevated and compressed, rising strongly to temporal impressions (in *canadensis* not compressed except at sagittal crest); postorbital processes much larger; rostrum more strongly ascending; occipito-sphenoid longer (98 mm. against 90); underjaw much longer; coronoid blade higher, its apex less recurved. Canines about same size; large upper premolar, upper molars, and $M_{\overline{1}}$ and $M_{\overline{2}}$ decidedly smaller.

Adult male (type) compared with adult male *caurinus:* Frontal shield broader, less elevated posteriorly; fronto-nasal region less strongly dished; coronoid blade less nearly vertical; upper canines slightly shorter; lower canines conspicuously smaller and shorter.

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[1] Restored.

Adult male (type) compared with adult male *eulophus* (type and older skulls): Similar in general, both having the fronto-facial region long sloping and flattish, but differing in many characters. The skull of *pervagor* differs from that of *eulophus* in being slightly shorter, less highly arched, frontal shield less elevated posteriorly; postorbitals larger, more horizontally outstanding; sagittal crest shorter and straighter, not arched; braincase, rostrum, and palate shorter; squamosal shelf shorter; postpalatal shelf broader and shorter; interpterygoid notch broader; underjaw smaller and less massive; inferior border of ramus shorter and less broadly expanded; coronoid lower, the apex less narrowed and less recurved, with less development of inferior ridge of fossa; teeth (canines and molars) slightly smaller.

Skull measurements.—Adult male (type): Basal length, 330; occipito-nasal length, 322; palatal length, 178; zygomatic breadth, 224; interorbital breadth, 81.

URSUS CAURINUS MERRIAM.

LYNN CANAL GRIZZLY.

Ursus caurinus Merriam, Proc. Biol. Soc. Washington, XXVII, p. 187, August 18, 1914.

Type locality.—Berners Bay, east side of Lynn Canal, Southeastern Alaska.

Type specimen.—No. 176591, ♀ ad., U. S. National Museum, Biological Survey collection. Collected June 8, 1911 by A. Hasselborg.

Range.—Coast of mainland of Southeastern Alaska from Chilkat River valley and Lynn Canal south an unknown distance.

Characters.—Very closely related to *eulophus* of Admiralty Island. Size rather large; skull long and rather narrow; canines long, the lower ones massive; claws smoothly polished.

Color.—Upperparts yellowish buff; face and most of head pale brown or drab; ears, hump, and underparts conspicuously darker; legs and feet dark brown or brownish black.

Cranial characters.—*Male and female:* Both skulls long and narrow, strongly arched posteriorly, moderately dished; frontal shield of medium breadth, strongly ascending; postorbital processes weak and decurved except in old age; frontal part of braincase elevated, forming an uplifted base for posterior part of frontal shield, behind which it keels into sagittal crest as in *eulophus;* palate long; postpalatal shelf rather narrow; squamosal shelf long; lachrymal duct opening within orbital rim; ramus of jaw broad and flattened, notably higher posteriorly than anteriorly. Teeth rather small for size of skull; last upper molar long and narrow, tapering posteriorly.

Unfortunately, no fully adult male *caurinus* has been obtained, but I have secured a skull of a young-adult male (No. 205169) from Berners Bay, Lynn Canal, and another (No. 210140) from Chilkat River valley. These present the following characters: Skull long, high, and narrow, rather highly arched and dished; frontals rising rather strongly from rostrum; frontal shield rather narrow, long sloping, convex transversely in these youngish skulls (doubtless flattish in adults), slightly sulcate medially; long pointed, the point nearly reaching parietals; postorbital processes rather broad and slightly decurved (doubtless more outstanding with age); fronto-nasal region dished; rostrum moderate; nasals nearly horizontal anteriorly, rising posteriorly into frontal shield; frontal part of braincase compressed and elevated, keeling into temporal impressions and anterior part of sagittal crest; squamosal shelves long. Underjaw rather long; ramus moderate, its inferior border bellied posteriorly; coronoid blade moderate and rather vertical; apex not strongly recurved; palate, postpalatal shelf and notch medium; teeth rather small for size of skull; molars only slightly larger than those of female; M^2 rather narrow, with narrow slightly everted heel; canines, especially lower canines, decidedly thicker than those of female; $M_{\overline{1}}$ rather swollen in both male and female; $M_{\overline{2}}$ small and narrowest posteriorly; $PM_{\overline{4}}$ with main cusp rather small, conical, anterior, with gradually sloping incompletely sulcate heel, rarely with traces of posterior cusplets, sometimes with anterior cusplet on inner side of cingulum.

The Chilkat Valley male is a year older than the Berners Bay skull, and broader across the frontals; postorbital processes more outstanding, ramus of underjaw more bellied posteriorly; coronoid blade broader above; $M_{\overline{1}}$ smaller and thinner.

Cranial comparisons.—Ursus caurinus appears to be rather closely related to *pervagor* of the Lillooet region in the interior of British Columbia, and to *eulophus* of Admiralty Island, Southeastern Alaska, but unhappily no skulls of fully adult males are available for comparison.

Young-adult male (No. 210140, from Chilkat River valley) compared with adult male *eulophus* (type) and with a young adult *eulophus* (No. 203284), both from Admiralty Island: Frontal shield narrower anteriorly and *much narrower posteriorly* (narrowed behind postorbitals by usual incurving temporal ridges, while in *eulophus* the ridges are nearly straight and the posterior part of shield correspondingly broader); fronto-nasal region more strongly dished; underjaw longer; ramus thicker (more swollen on outer side); coronoid blade broader above and much less recurved. Canines essentially same; $M_{\overline{1}}$ smaller; M^2 broader in middle and posteriorly.

Adult female (type) compared with young-adult female *eulophus* (No. 137470): Basal, occipito-nasal, and occipito-sphenoid lengths essentially same; vault of cranium much less arched; frontal shield flatter, narrower interorbitally and postorbitally; postorbitals much smaller and outstanding instead of strongly decurved; fronto-nasal region scarcely dished; rostrum lower; nasals smaller; palate shorter; underjaw more massive; coronoid broader and less recurved; $M_{\overline{1}}$ thicker; M^2 narrower throughout, the heel narrowed on outer side.

Young-adult male compared with adult male *pervagor:* Frontal shield narrower, more elevated posteriorly; fronto-nasal region more strongly dished; coronoid blade more nearly vertical. M^2 narrower, with narrower heel. Upper canines slightly longer; lower canines conspicuously longer and larger.

Skull measurements.—Adult female (type): Basal length, 295; occipito-nasal length, 285; palatal length, 161; zygomatic breadth, 196; interorbital breadth, 66.

URSUS EULOPHUS MERRIAM.

ADMIRALTY ISLAND CRESTED BEAR.

Ursus eulophus Merriam, Proc. Biol. Soc. Washington, XVII, p. 153, October 6, 1904.

Type locality.—Admiralty Island, Southeastern Alaska.

Type specimen.—No. 81102, ♂ ad., U. S. National Museum, Biological Survey collection. Collected in 1896 by Lieut. G. T. Emmons.

Range.—Admiralty Island.

Characters.—Size large; color rich dark brown; claws blue-black, of moderate length; skull long, rather narrow, and high, with weak decurved postorbital processes.

Color.[1]—General color of head and body in fresh pelage, rich dark brown or seal brown; muzzle paler; legs, feet, and belly dusky or blackish; neck and shoulders sometimes grizzled by admixture of yellowish-tipped hairs.

Cranial characters.—*Adult males:* Skull large, long, high, and rather narrow; frontal shield long and rather narrow, shallowly grooved medially, gradually sloping (not abruptly elevated); temporal impressions long and only slightly incurved, meeting at frontoparietal suture; postorbital processes weak and decurved; frontonasal region elevated in plane of shield; rostrum long and high; anterior third of nasals horizontal, posterior two-thirds rising in fronto-nasal plane; zygomata moderately spreading, subangular; squamosal root only slightly expanded; palate and postpalatal shelf long and narrow; ascending arms of maxillæ long, passing far beyond nasals and reaching back over anterior two-thirds of orbit; nares rather small; braincase long anteriorly, rather narrow, compressed, and keeling into sagittal crest; sagittal crest high, curved, and relatively short; ramus of jaw high vertically, its inferior border *strongly bellied* posteriorly; coronoid blade large and moderately high. Canines long; molars rather small for so large a skull.

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[1] Color from skins in Mus. Vert. Zool., Univ. California, obtained on Admiralty Island by Miss Annie M. Alexander.

Cranial comparisons.—Adult male (type) compared with adult male *pervagor* (type): Skull longer; arch of cranium higher; frontal shield longer sloping, rising higher posteriorly; rostrum longer; braincase longer; sagittal crest more convex; palate and postpalatal shelf longer; shelf and notch narrower; underjaw larger, longer, more massive; inferior border of ramus longer, more strongly bellied posteriorly and broader vertically; coronoid fossa deeper, its inferior border much more sharply defined by strongly developed ridge for muscular attachment. Canines and molars larger.

Skull measurements.—Adult male (type): Basal length, 346; occipito-nasal length, 343; palatal length, 190; zygomatic breadth, 221; interorbital breadth, 81.

URSUS KLAMATHENSIS MERRIAM.[1]

KLAMATH GRIZZLY.

Ursus klamathensis **Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 185–186, August 13, 1914.**

Type locality.—Beswick, near mouth of Shovel Creek, Klamath River, northern California.

Type specimen.—No. 178735, ♂ ad., U. S. National Museum, Biological Survey collection. Collected and presented by Charles Farwell Edson.

Range.—Siskiyou Mountains of northern California and southern Oregon, ranging north in recent times to Fort Klamath region and Rogue River valley; in early days to lower Willamette Valley (presumably same species); south in Sierra Nevada an unknown distance. (Skull from lower McCloud River referred to this species.)

Characters.—Size of male large; skull in general of the *idahoensis* type, but larger and with heavier canines. Claws moderate, rather strongly curved, horn color, washed with yellowish basally and with pale yellowish markings at tips, marked longitudinally with fine parallel striæ. Skin characters unknown.

Cranial characters.—Skull large and high, highest about 40 mm. in front of fronto-parietal suture; rostrum long, high, and ascending in plane of frontal shield; fronto-nasal region elevated, scarcely if at all dished; frontal shield broad, flat, sloping, and rather short pointed; postorbital processes moderate, peglike, horizontally outstanding; sagittal crest long and well developed; lachrymal duct opening on orbital rim (rather posteriorly than anteriorly); zygomata moderately spreading, only moderately expanded vertically; anterior (frontal) part of braincase keeling into sagittal crest; occiput produced posteriorly (overhang much greater than in *californicus*); squamosal shelves long and broad; palate rather flat, slightly arched lengthwise; postpalatal shelf broad and flat; occipitosphenoid short for so large a skull (length 89 mm.); basioccipital very broad anteriorly; mastoids vertical and short. Underjaw long; ramus exceptionally broad and flat vertically; coronoid blade large and high, broad basally. Canines very large; molars moderate; last upper molar relatively small, the heel emarginate or obliquely truncate on outer side; middle lower molar with anterior moiety much larger than posterior. Large upper premolar absent and no trace of alveolus.

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[1] **Tentatively included in *arizonæ* group. (See Introduction, pp. 12–13.)**

Cranial comparisons.—Curiously enough *klamathensis* does not require close comparison with any of the other species inhabiting California, its only near relatives being members of the *shoshone-idahoensis* group of the Rocky Mountains, and *pervagor* of interior British Columbia.

Adult male (type) compared with old male *idahoensis* (No. 187888, =No. 93, Merriam collection, from North Fork Teton River, eastern Idaho): Similar in general form and proportions but larger (condylobasilar length 350 mm. contrasted with 335); vault of cranium somewhat higher; frontal shield broader and flatter; palatal length about the same; postpalatal length much greater (150 contrasted with 135); opening of lachrymal duct slightly more posterior; occipital overhang greater; basioccipital anteriorly very much broader; ramus of underjaw longer and much broader vertically; coronoid blade higher. Canines larger and longer; last upper molar shorter.

Adult male (type) compared with adult male *pervagor* (type): Similar in size and general characters; vault of cranium slightly higher; frontal shield flatter and somewhat broader; postorbitals not quite so large; fronto-nasal region more elevated (in *pervagor* slightly dished); rostrum broader anteriorly; occipital overhang greater; ramus of underjaw much more broadly expanded vertically and flatter; canines and molars very much larger.

Adult male (type) compared with old male *henshawi* (type): *Ursus klamathensis* and *U. henshawi* belong to widely different groups and do not require detailed comparison. *U. klamathensis* may be distinguished at a glance by its much larger size, much higher vault of cranium, highly elevated and continuously sloping fronto-nasal region and rostrum, and peglike postorbitals—in striking contrast to the much smaller, lower, and strongly dished skull of *henshawi*, with its low depressed rostrum and large broadly rounded postorbitals.

Adult male (type) compared with adult male *californicus* (from coast region south of San Francisco Bay): The differences are marked in the skull and striking in the teeth. In *klamathensis* the vault of the cranium is lower posteriorly and higher anteriorly; the frontal shield flatter laterally; the rostrum shorter; the base of the cranium (occipito-sphenoid) decidedly shorter. The last upper and middle lower molars are widely different, the heel of $M^{\underline{2}}$ in *californicus* large, long, and broad posteriorly, while in *klamathensis* it is small and emarginate on outer side; the anterior part of $M_{\overline{2}}$ in *californicus* is normal, while in *klamathensis* it is disproportionately large.

Skull measurements.—Adult male (type): Basal length, 331; occipito-nasal length, 337; palatal length, 175; zygomatic breadth, 223; interorbital breadth, 85.5.

URSUS MENDOCINENSIS MERRIAM.[1]

MENDOCINO GRIZZLY.

Ursus mendocinensis Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 145–146, September 6, 1916.

Type locality.—Long Valley, Mendocino County, California.

Type specimen.—No. 206625, ♂ old, U. S. National Museum, Biological Survey collection. Obtained through Charles J. and Frank H. Hittell.

Characters.—Size rather large, about equaling *klamathensis* but apparently smaller than *californicus* and *colusus;* external characters unknown. Affinities with *klamathensis*, with which it may intergrade at the north.

Cranial characters.—Skull short, broad, highly arched, and strongly dished, with widely outstanding zygomata and truncate occiput. Frontal shield of moderate breadth, short pointed posteriorly, slightly convex between orbits, strongly sloping to rostrum; rostrum short, broad, and strongly depressed; postorbital processes moderate, sub-peglike, horizontally outstanding; sagittal crest high, thick, humped anteriorly, short posteriorly; occiput obliquely truncate; occipital overhang slight compared with that of *californicus* and *colusus;* palate short and rather broad; postpalatal shelf of moderate breadth, flat; postpalatal notch moderate; mastoids rather short, directed anteriorly. Underjaw absent. Teeth gone except left hind molar, which is short, with small heel, obliquely truncate on outer side (as in *klamathensis*).

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[1] Tentatively included in *arizonæ* group. (See Introduction, pp. 12–13.)

Cranial comparisons.—Similar in general to *klamathensis* but fronto-nasal region strongly dished, *rostrum shorter, broader, flatter on top, and depressed instead of elevated;* zygomata more widely outstanding; palate broader; occipital overhang less.

Skull measurements.—Old male (type): Basal length, 327; occipito-nasal length, 323; palatal length, 183; interorbital breadth, 84.5.

URSUS MAGISTER MERRIAM.[1]

SOUTHERN CALIFORNIA GRIZZLY.

Ursus magister Merriam, Proc. Biol. Soc. Washington, XXVII, p. 189, August 13, 1914.

Type locality.—Los Biacitos, head of San Onofre Canyon, Santa Ana Mountains, Southern California.

Type specimen.—No. 160155, ♂ old, U. S. National Museum, Biological Survey collection. Killed in August, 1900 or 1901, by Henry A. Stewart and by him presented to the Biological Survey.

Range.—Santa Ana or Trabuco Mountains, Cuyamaca and Santa Rosa Mountains, and probably San Jacinto Mountains. Believed to be extinct.

Characters.—Size of male huge (estimated weight over 1,400 pounds), largest of known grizzlies, considerably larger than *californicus* of the Monterey region, and even than *horribilis*, the great buffalo-killing grizzly of the Plains (only equaled by the largest *alexandræ* of Kenai Peninsula); sexual disparity great; skull of female hardly half the bulk of male; skull of male of a rather generalized type; not dished. Claws of old female from head of Trabuco Canyon, Santa Ana Mountains, exceedingly long, strongly curved, mainly yellowish above.

Color.—(Old female from head of Trabuco Canyon): General color dusky or sooty all over except head and grizzling of back. Muzzle gray or mouse brown, palest above; top of head and neck very dark brown, sparsely grizzled with pale-tipped hairs; back dusky grizzled with grayish; legs and underparts wholly blackish.

Cranial characters.—Adult male (type): Skull exceedingly large, long; vault of cranium arched, but not abruptly; rostrum long and high; fronto-nasal region elevated, in same plane with frontal shield and rostrum; frontal shield flattish-convex, faintly sulcate medially and slightly swollen on each side between postorbital processes, the point decurved and reaching fronto-parietal suture; zygomata only moderately spreading, angular, the posterior root expanded and rising abruptly from plane of squamosal shelf; sagittal crest rather short; palate scooped out anteriorly, forming a basinlike depression surrounding the anterior palatine foramina; occipito-sphenoid length 103.5 mm. Underjaw long; ramus broad and flat vertically, its inferior border moderately bellied and incurved posteriorly; coronoid blade large, its apex strongly recurved, cutting plane of middle of condyle. Teeth large and broad but by no means disproportionate to large size of skull; M^1 broad; last upper molar absent, but from its alveolus and its form in female, obviously broad, short, strongly triangular, the heel small, narrowed posteriorly, obliquely emarginate on outer side; $\text{PM}_{\overline{4}}$ broad, with rather short slightly sloping heel, narrow imperfect sulcus without posterior cusplets; $\text{M}_{\overline{1}}$ apparently normal (much worn in type specimen); middle lower molar absent in type specimen but apparently normal (judging from the female, in which, however, it is badly worn).

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[1] Tentatively included in *arizonæ* group. (See Introduction, pp. 12–18.)

Female of extreme age (No. 156594, from Trabuco Canyon, killed January 5, 1908, by Andrew Joplin and Edward Adkinson): Size small; rostrum short and depressed; fronto-nasal region strongly dished; frontal shield flattish, slightly sulcate interorbitally, short pointed, beaded posteriorly by elevated temporal impressions, rising rather abruptly at orbits; sagittal crest long and nearly horizontal; palate and postpalatal shelf broad, flat posteriorly, concave anteriorly.

Cranial comparisons.—Ursus magister does not require close comparison with any other species. While the largest skulls of old male *californicus* equal it in basal length, they are so much lower, narrower, and smaller in every way that detailed comparisons are unnecessary. The species which it most nearly resembles is *bairdi* from the mountains of Colorado, but the resemblance is not close. It differs from *bairdi* in somewhat larger size, much more highly arched vault of cranium, much broader and more strongly sloping frontal shield, more posterior mastoids, longer underjaw with much more broadly flattened and less massive ramus, and in important tooth characters.

Between the two geographically is *utahensis*, which, like *magister*, has the ramus of the underjaw very broadly flattened vertically, but in form of cranium *utahensis* goes to the opposite extreme, the frontal shield, rostrum, and braincase being exceptionally narrow, and the fronto-nasal region compressed and elevated.

Flesh measurements.—Old male (type): Height at shoulder from flat of foot 4 ft. (=1,220 mm.); total length, snout to tail, 9½ ft.[1] (=2,900 mm.); sole of largest foot without claws: length 12 in. (=305 mm.); breadth 8 in. (=204 mm.). Length of old female from Trabuco Canyon, measured in the flesh by Andrew Joplin, 6 ft. 3 in.

Skull measurements.—Old male (type): Basal length, 365; occipito-nasal length, 366; palatal length, 197; zygomatic breadth, 236; interorbital breadth, 97.

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[1] Apparently an error; possibly intended for snout to claws of extended hind foot.

Hylodromus Group.

URSUS HYLODROMUS Elliot.

Forest Grizzly.

(Plate XI.)

Ursus hylodromus Elliot, Field Columb. Mus. Pub. 87, Zool. Ser. III, pp 257–258, December, 1913. (Described as a black bear!) Purchased from Mackay & Dippie, taxidermists, Calgary.

Ursus selkirki Merriam, Proc. Biol. Soc. Washington, XXIX, p. 150, September 6, 1916. (From Selkirk Mountains, Upper Columbia River, British Columbia.)

Type locality.—Rocky Mountains of western Alberta (precise locality unknown).

Type specimen.—No. 19065, ♀ young-adult, Field Museum of Natural History.

Range.—Rocky Mountain region of western Alberta and eastern British Columbia, including Selkirk Range.

Characters.—Size of male large, of female small; external characters unknown.

Cranial characters.—*Young-adult female* (type[1]): Size small, skull short posteriorly (occiput less extended than in most species); moderately arched and dished; zygomata not outstanding and only slightly bowed; frontal shield of moderate breadth, rising rather strongly from rostrum, its apex sublyrate; postorbital processes large, outstanding; rostrum rather high, strongly ascending posteriorly; sagittal crest short, reaching only two-thirds distance from occiput to fronto-parietal suture; squamosal shelf narrow and nearly horizontal; postpalatal shelf rather broad.

Old male (No. 205170) from Selkirk Mountains, upper Columbia River, British Columbia (assumed to be typical): Size medium; skull long, low arched, highest immediately in front of fronto-parietal suture, and of medium breadth; braincase and palate arched; shield flattish, long pointed, sloping gradually from point to rostrum, faintly sulcate medially; postorbitals broadly subtriangular, flat on top and slightly decurved, convex posteriorly, concave anteriorly; rostrum moderate, nearly horizontal; fronto-nasal region rising very gradually into shield; sagittal crest short; palate of medium breadth, slightly troughed and arched; postpalatal shelf broad and flat; zygomata subtriangular, not widely outstanding, strongly arched anteroposteriorly; squamosal root long but not broadly expanded; mastoids short, not divergent; meatus tube large and free; ramus of underjaw straight; coronoid blade low, broad in middle part. Teeth of medium size (too badly worn to admit of description).

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[1] Through the courtesy of the officials of the Field Museum I have had the privilege of examining the type skull of *hylodromus* and comparing it with skulls in the National Museum collection.

Cranial comparisons.—Old male (No. 205170, from Selkirk Mountains) compared with old male *kluane* (type): Size smaller; vault of cranium materially lower; top of skull lower and flatter throughout; shield narrower, much flatter, and longer pointed; sagittal crest much shorter and lower; occipital overhang and inion much less developed; zygomata more triangular (less bowed); braincase, palate, and underjaw much shorter; coronoid blade lower; subangular border shorter and more strongly defined. Teeth very badly worn but canines and molars evidently much smaller.

Compared with *idahoensis* and *chelan* (both types): Similar in general but smaller; vault of cranium *much lower;* frontal shield somewhat narrower, longer pointed posteriorly; postorbital processes broader basally but less widely outstanding; sagittal crest much shorter, its anterior part less distinctly keeled from sinus case; zygomata shorter and more sharply triangular; underjaw shorter; coronoid blade lower; subangular notch and border similar.

Compared with *latifrons*, whose range it approaches on the north but with which it does not appear to be related, it is easily distinguished by smaller size, flatter and very much narrower frontal shield, more elevated and evenly sloping fronto-nasal region, less outbowed and more triangular zygomata, much shorter underjaw and ramus, and much lower coronoid blade.

Remarks.—The type specimen of *hylodromus* is a skull of a young-adult female from western Alberta, exact locality unknown. Until recently so few males have been available from this region that I was long in doubt as to which was its proper mate. In the light of present material, however, it has been possible to match up males and females of most of the species of eastern British Columbia and western Alberta with some confidence; and I now feel reasonably certain that the type specimen of the species described by me as *Ursus selkirki* from the Selkirk Mountains on the upper Columbia River is in reality an old male *hylodromus*, the name *selkirki* thus falling as a synonym.

Skull measurements.—Old male (No. 205170) from Selkirk Mountains: Basal length, 305; occipito-nasal length, 306; palatal length, 169; zygomatic breadth, 206; interorbital breadth, 74. Female young-adult (type): Basal length, 275; occipito-nasal length, 257; palatal length, 154; zygomatic breadth, 173; interorbital breadth, 69.

URSUS KLUANE KLUANE MERRIAM.

KLUANE GRIZZLY.

Ursus kluane Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 141-143, September 6, 1916.

Type locality.—McConnell River, Yukon.

Type specimen.—No. 204188, ♂ old, U. S. National Museum, Biological Survey collection. Collected by Smith and Geddis July 15, 1914.

Range.—Southwest corner of Yukon Territory east of the St. Elias Range, extending northwesterly in Alaska to Mount McKinley region (head of Toklat), easterly in Yukon Territory to McConnell River (north-northeast of Teslin Lake) and probably south into northwest corner of British Columbia.

Cranial characters.—*Adult male:* Skull medium, rather long, narrow, somewhat arched and dished, with long braincase, long convex sagittal crest, and unusually broad decurved postorbitals. Frontal shield of medium width, strongly convex both transversely and antero-posteriorly, rising rather strongly from rostrum, slightly sulcate medially and moderately swollen over orbits; very short pointed, the point ending about midway between parietals and plane of postorbitals; postorbitals broad, decurved, strongly convex anteriorly, concave posteriorly; fronto-nasal region somewhat depressed; rostrum high and narrow, rounded above (subterete); nares truncate; sagittal crest very long and arcuate; occipital overhang and inion well developed; zygomata not widely outstanding, somewhat bowed, rounded posteriorly; palate moderate; postpalatal shelf large and broad; notch rather broad and short; mastoids long and divergent; underjaw rather long; coronoid blade high and narrow, the apex rather strongly recurved; teeth too badly worn to admit of description (apparently large for size of skull).

Adult female: Size small, nearly as small as female *pallasi;* fronto-nasal region moderately dished and usually sulcate; braincase moderately arched, highest just in front of fronto-parietal suture; temporal impressions meeting over anterior part of parietals (probably somewhat more anteriorly in old skulls); zygomata moderately outbowed, subtriangular; frontal shield of medium breadth, lyrate pointed posteriorly; postorbital processes rather broad for so small a skull, moderately decurved; underjaw short; coronoid blade broad basally and rather short. Teeth (canines, incisors, and molars) rather large for size of skull, decidedly larger than in *pallasi;* molars, both upper and lower, very much larger.

Cranial comparisons.—The species requiring comparison with *kluane* are *toklat*, *pulchellus*, and *pallasi.* Old male (type) compared with old male *toklat*, from Alaska Range, near north base of Mount McKinley: Size slightly larger; occipito-nasal length, length of braincase, and length of sagittal crest very much greater; frontal shield more convex transversely; postorbital processes much larger and broader; rostrum higher, more rounded on top; nares more squarely truncate; underjaw longer; inferior border of ramus more convex posteriorly; coronoid blade decidedly higher, narrower above, the apex more strongly recurved; teeth badly worn in both, but canines decidedly longer in *kluane;* molars apparently somewhat larger.

Compared with adult male *pulchellus:* Similar in general, but skull as a whole, braincase, palate, and underjaw *very much longer;* frontal shield *very much broader;* inferior border of ramus less abruptly upcurved; subangular border less nearly horizontal and much less sharply defined.

Adult female compared with adult female *toklat* (comparison hardly necessary because of the great difference in size): Basal length at least 20 mm. less; vault of cranium and frontal shield lower; braincase less constricted anteriorly; posterior part of shield much longer and broader, reaching or passing the fronto-parietal suture; sagittal crest much shorter; postpalatal shelf less broad; underjaw and inferior border of ramus shorter; coronoid blade about same height; canines about same size; molariform series (upper and lower) about same length, but proportions of individual teeth different: M^1 much larger; M^2 with shorter heel; $M_{\overline{1}}$ larger.

Old male (type) compared with old male *pallasi* (type): Size decidedly greater; skull about an inch longer and much more highly arched, with conspicuously longer braincase and longer sagittal crest; crest strongly arched instead of nearly straight; postorbitals very much larger, broader, and more strongly decurved; fronto-nasal region much more elevated and less dished; rostrum much higher, rounded above instead of depressed; palate much longer, more arched and more concave; underjaw much longer; coronoid higher.

Adult female compared with adult female *pallasi:* Skulls very much alike in size and appearance (that of *kluane* slightly larger), but teeth strikingly different. In *kluane*, canines larger; molars very much larger.

Skull measurements.—Old male (type): Basal length, 317; occipito-nasal length, 324; palatal length, 177; zygomatic breadth, 210; interorbital breadth, 85.

URSUS KLUANE IMPIGER subsp. nov.

Industrious Grizzly.

Type No. 210708, ♂, not quite fully adult. From Columbia Valley, British Columbia. Collected in April, 1914, by Mackay & Dippie.

Cranial characters.—Adult male: Similar in general to *kluane* (No. 221620, ♂ ad., Kluane River), but shield narrower and less sulcate, less swollen over orbits; nasals less elevated; palate much shorter and narrower; postpalatal shelf narrower; underjaw shorter; subangular border shorter; subangular notch and space much more strongly defined. Teeth smaller throughout, especially M^2 and $M_{\overline{2}}$, but $M_{\overline{1}}$ swollen as in *kluane*.

Female young-adult from Brisco,[1] Columbia Valley (No. 210707): Vault well arched; shield posteriorly broadly lyrate, elevated by rising sinus case; rostrum long and slender; fronto-nasal region dished; palate long, troughed; underjaw long and straight. Teeth large.

Cranial comparisons.—Male young-adult (type) compared with old male *hylodromus* from Selkirk Mountains (No. 205170): Vault of cranium much more highly arched and narrower, the narrow frontal shield rising higher and more strongly, but not abruptly, from rostrum; shield strongly convex (in old *hylodromus* nearly flat); postorbitals much more slender, outstanding, depressed, and somewhat decurved as in *kluane;* fronto-nasal region more dished; palate narrower; inferior border of underjaw much longer; subangular border shorter; coronoid blade higher.

Female young-adult (No. 210707) compared with female *kluane:* Skull as a whole, rostrum, occipito-sphenoid, palate, and underjaw much longer; ramus straighter; subangular border same; teeth essentially same except that $M_{\overline{1}}$ is smaller. Compared with female *hylodromus* (type): Skull as a whole, rostrum, occipito-sphenoid, palate, and underjaw longer (but not so much longer as in comparison with female *kluane*); ramus straighter; subangular border shorter; teeth similar.

Remarks.—Ursus hylodromus, U. impiger, and *U. kluane* form a rather closely related group ranging from western Alberta and southeastern British Columbia northwesterly to southwestern Yukon. From the material now in hand *impiger* appears to be most nearly related to *kluane*, but additional skulls of adults may show that its affinities with *hylodromus* are equally close.

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[1] Skulls of females identified as *impiger* have been examined from Brisco, Columbia Valley, British Columbia (No. 210707); Morley, Alberta (No. 210706); Jasper, Alberta (No. 222745); and headwaters North Fork Blackfoot River, western Montana (No. 203188).

Skull measurements.—Adult male (type): Basal length, 309; occipito-nasal length, 293; palatal length, 162; zygomatic breadth, 197; interorbital breadth, 72.

URSUS PELLYENSIS SP. NOV.

PELLY GRIZZLY.

Type No. 215477, ♂ young-adult, U. S. National Museum, Biological Survey collection. From the Ketza Divide, Pelly Mountains, Yukon. Collected September 30, 1915, by Fred E. Enevoldsen.

Characters.—Skull of medium size, rather long and narrow, apparently related to *hylodromus*: Frontal shield narrow, long pointed (point reaching fronto-parietal suture but in older specimens ending much more anteriorly), rising strongly from rostrum; rostrum rather narrow and high; fronto-nasal region dished; postorbitals broad, strongly decurved (in old skulls doubtless more outstanding); sinus case keeling into posterior part of shield; palate moderate (rather broad for so narrow a skull), slightly arched and slightly troughed; underjaw long for size of skull; inferior border of ramus long, not upturned; subangular border short; coronoid rather high; canines long, the lower ones large for size of skull; molars long and narrow, especially $M_{\overline{1}}$ and $M_{\overline{2}}$; anterior part of $M_{\overline{2}}$ exceptionally long and posterior part relatively narrower than in most species; $PM_{\overline{4}}$ subconical.

Female skull (based on four rather old specimens from Pelly and Ross Mountains, Nos. 215710, 215711, 215713, and 221600): Size small; frontal shield of moderate breadth, rather short pointed posteriorly, entering sagittal crest anterior to fronto-parietal suture; postorbital processes well developed, outstanding; rostrum rather small; frontal shield rising moderately from rostrum, shallowly sulcate medially; zygomata subtriangular. Dentition moderate; heel of last upper molar slightly emarginate, rounded posteriorly; canines small and slender.

Cranial comparisons.—Young-adult male (type) compared with young-adult male *hylodromus* (No. 210708 from Columbia Valley, British Columbia): Size smaller (basal length about 10 mm. less); vault of cranium less highly arched; sinus case more definitely keeled to support posterior part of shield; postorbitals broader, more decurved, less outstanding; palate broader; molar series about same; upper canines essentially same; lower canines larger; upper molar series essentially same length; lower molar series longer and narrower; $M_{\overline{1}}$ much longer and more slender.

Young-adult male (type) compared with adult male *pulchellus* from the neighboring Ross River (No. 221599): Size slightly greater; shield and rostrum broader (in *pulchellus* exceptionally narrow); postorbitals broader and more decurved; palate longer and broader; postpalatal notch much shorter; coronoid blade larger; molars, upper and lower, strikingly narrower and less massive.

Female *pellyensis* compared with female *toklat:* Size smaller; vault *much lower and depressed*—sinus case not keeled into front of sagittal crest; fronto-nasal region less strongly depressed and dished; rostrum and nasals flatter; palate about same length; postpalatal length much less; underjaw much shorter. Canines smaller; molar series shorter; heel of M^2 less elongate.

Skull measurements.—Young-adult male (type): Basal length, 299; occipito-nasal length, 294; palatal length, 168; zygomatic breadth, 186; interorbital breadth, 73.

URSUS ANDERSONI[1] SP. NOV.[2]

ANDERSON BEAR.

Type No. 34402, ♂ ad. (rather old), American Museum of Natural History. Collected on east branch Dease River[3] near Great Bear Lake, Mackenzie, May 12, 1911, by Dr. R. M. Anderson.

Characters.—Size medium or rather large; frontal region including postorbitals rather flat and narrow as in *pellyensis* (in strong contrast with the broader swollen frontals and elevated outstanding postorbitals of *richardsoni*); vault moderately arched.

Cranial characters.—Frontal shield rather narrow, strongly sloping, flattened, short pointed posteriorly; postorbitals moderate (short in contrast with those of *richardsoni*), horizontal (not decurved); sagittal crest long and strongly developed, humped anteriorly, projecting posteriorly in prominent inion; rostrum narrow, rather high, compressed below middle of nasals; orbits strongly sloping (retreating); occipital overhang marked; squamosal shelf long; palate long and narrow; postpalatal shelf moderate; zygomata well outstanding and somewhat bowed. Underjaw moderate; coronoid blade strongly recurved, apex sharp pointed. Molars broad and rather large: M^1 and M_2 together 62 mm. (in type skull); lower molars 74 mm. Canines large (too much broken to afford measurements).

Cranial comparisons.—The adult male resembles, though not very closely, both *pellyensis* and *tahltanicus*. Compared with the type specimen of *pellyensis:* Size essentially same; shield shorter and flatter with more horizontally outstanding postorbitals (differences attributable in large part at least to difference in age); zygomata much less broadly outstanding (also attributable to age); postpalatal notch decidedly longer; coronoid blade lower. Canines apparently larger (badly broken); molars broader and more massive. Compared with an old male (No. 134486) from Macmillan River, presumably old *pellyensis*, it is much smaller and narrower; shield narrower, flatter, and shorter posteriorly; postorbitals flatter and more nearly horizontal on top; rostrum narrower; sagittal crest longer and rising higher anteriorly; palate, postpalatal shelf, diastema, and occipito-sphenoid much shorter; underjaw much shorter; coronoid lower. Dentition heavier; canines and molars larger.

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[1] Named for Dr. R. M. Anderson, who collected the type specimen.

[2] Tentatively included in *hylodromus* group. (See Introduction, pp. 12–13.)

[3] Not to be confused with the better-known Dease River of northern British Columbia.

Compared with old male *tahltanicus* (type), with which it agrees essentially in size, height of vault of cranium, slope and flatness of shield, form of rostrum, spread and form of zygomata, and size and form of underjaw, it differs as follows: Shield narrower both interorbitally and across postorbitals; point of shield much shorter; fronto-nasal region slightly dished (in *tahltanicus* not dished); sagittal crest much longer, higher anteriorly, and keeled from sinus case. Dentition heavier; canines and molars much larger.

Skull measurements.—Adult male (type): Basal length, 300; occipito-nasal length, 285; palatal length, 165; zygomatic breadth, 211; interorbital breadth, 76.

Horriæus Group.

URSUS APACHE MERRIAM.

APACHE GRIZZLY.

Ursus apache Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 134–135, September 6, 1916.

Type locality.—Whorton Creek, south slope of White Mountains, eastern Arizona (a few miles west of Blue).

Type specimen.—No. 212436, ♂ ad., U. S. National Museum, Biological Survey collection. Collected April 3, 1913, by B. V. Lilly.

Cranial characters.—Skull short, broad, and low, rather massive, moderately dished, with broad frontal shield and exceedingly broad outstanding postorbitals. Frontal shield broad, shallowly sulcate medially between orbits; very slightly and rather flatly swollen over orbits; long pointed posteriorly, meeting short sagittal crest at fronto-parietal suture; rostrum short, high, and rather narrow; *zygomata strongly outbowed and outstanding anteriorly as well as posteriorly;* ramus of jaw rather short, bellied under last molars; coronoid blade high, sloping strongly outward, the apex overarching shallow coronoid notch, but not cutting plane of condyle; dentition moderate.

Cranial comparisons.—Old male (type) compared with old male *horriæus* (type): Size somewhat greater; vault of cranium materially higher; shield much broader both interorbitally and across postorbital processes; the posterior part much longer and horizontal or sloping posteriorly (in *horriæus* short and sloping strongly forward from apex of posterior point); sagittal crest very much shorter; palate broader and flat (in *horriæus* concave and arched); zygomata broadly outbowed (in *horriæus* narrowly triangular); meatus tube strongly compressed between mastoid and glenoid (in *horriæus* large and free); underjaw much more massive; ramus longer; broadly expanded vertically and upcurved posteriorly; coronoid blade higher. Teeth apparently similar (in *horriæus* badly worn).

Compared with adult male *absarokus*, to which it appears to be related, the skull of *apache* differs as follows: Vault of cranium lower, less arched; frontal shield broader and flatter; postorbitals much broader and flatter, standing out more horizontally; fronto-nasal region more depressed; rostrum shorter; *orbits notably smaller* (lower vertically); squamosal trough shorter antero-posteriorly; zygomata very much more strongly outbowed and conspicuously more outstanding anteriorly; underjaw and inferior border of ramus shorter; coronoid blade of equal height; teeth slightly smaller (difference slight).

Old male (type) compared with adult male *arizonæ* (type): Basal length, occipito-nasal length, length of palate, interorbital breadth, and occipito-sphenoid length essentially the same; zygomata very much more outstanding and bowed instead of subtriangular; frontal shield less flat, of essentially the same breadth interorbitally as in *arizonæ*, but very much wider across postorbital processes, rising strongly from plane of rostrum; postorbital processes much more broadly outstanding; orbital rims more swollen; fronto-nasal region much less elevated; rostrum much smaller, narrower, less swollen, depressed basally, and horizontal instead of tapering; palate and postpalatal shelf much narrower. Underjaw stronger; ramus broader vertically; coronoid blade higher; molars slightly smaller; heel of M^2 shorter, less distinctly emarginate on outer side (more tapering).

Skull measurements.—Adult male (type): Basal length, 325; occipito-nasal length, 315; palatal length, 171.5; zygomatic breadth, 234; interorbital breadth, 89.

URSUS HORRIÆUS Baird.

New Mexico Grizzly.

(Pl. XV.)

Ursus horribilis var. *horriæus* Baird, Mammals North Amer., Pacific RR. Reports, VIII, pp. 224, 225, 1857 (name, type locality, and measurements).

Ursus horribilis var. *horriæus* Baird, Mammals Mexican Boundary Survey, pp. 24–29, 1859. (Full description, including a specimen from Nogales, since made the type of another species—*kennerlyi*.)

Ursus (Danis) horriaceus Gray, Catalog. Carn., Pach., and Edent., British Museum, p. 229, 1869.

Type locality.—Coppermines, southwestern New Mexico.

Type specimen.—No. 990, ♂ old, U. S. National Museum. Collected in 1855, by J. H. Clark.

Range.—Parts of New Mexico, south to Casas Grandes, Chihuahua, Mexico; probably extending into eastern Arizona.

Characters.—Size medium; external characters unknown; skull low and flat with broad outstanding postorbital processes.

Cranial characters.—*Old male* (type): Skull long, low, narrow, and flat; frontal shield short pointed posteriorly, temporal impressions conspicuously beaded, curving strongly inward, and meeting halfway between plane of postorbital processes and fronto-parietal suture; frontal shield flattish, shallowly concave, swollen over orbits; postorbital processes large, broad, widely outstanding and moderately decurved; fronto-nasal region slightly dished; rostrum narrow; sagittal crest long and rather high; occipital overhang and inion marked; zygomatic arches angular, rather squarely but not widely spreading posteriorly; squamosal root of zygoma moderately expanded vertically; lachrymal duct cutting orbital rim anterior to orbit; palate and interpterygoid fossa rather narrow. Teeth of medium size (badly worn in type).

An *old female* (No. 67405, from mountains north of Silver City, New Mexico, near type locality), collected in 1893 by Dr. A. K. Fisher, is assumed to be *horriæus*. Unfortunately the occipital region is absent so that measurements of length can not be taken. Skull low, with moderately spreading angular zygomata, flat long-pointed frontal shield, elevated flat fronto-nasal region (in plane of shield), and narrow rostrum, without trace of dishing except slight change of angle at middle of nasals; highest point of cranium about 25 mm. anterior to fronto-parietal suture; postorbital processes moderate or weak, subtriangular, slightly decurved; lachyrmal duct cutting orbital rim anteriorly; rostrum somewhat compressed a little below nasals; palate short (145), concave between last molars; postpalatal shelf moderately broad, short, and flat. Teeth small.

Cranial comparisons.—Old male (type) compared with old male *apache* (type): Size somewhat smaller; vault of cranium lower; shield much narrower, the point much shorter; palate concave and arched instead of flat; zygomata narrowly triangular instead of broadly outbowed; ramus of jaw shorter.

Old male (type) compared with adult male *shoshone* (type): Size essentially the same (basal length slightly less but occipito-nasal length same); vault of cranium much lower and flatter; frontal shield much lower and more nearly horizontal, less strongly sloping, slightly broader, more swollen over orbits, and broadly depressed interorbitally instead of flat or slightly convex; postorbital processes very much larger, broader, and more widely outstanding; frontal part of braincase broader and depressed—not keeling into sagittal crest; zygomata angular—not outbowed; occipito-sphenoid shorter; lachrymal duct more anterior; inferior border of ramus shorter; coronoid blade less high.

Old female compared with old females of *nelsoni:* Size larger (basal length about 10 mm. longer); vault of cranium higher over posterior frontal region; frontal shield broader, flatter anteriorly; zygomatic arches slightly more spreading. Teeth, especially canines and molars, materially larger.

Skull measurements.—Old male (type): Basal length, 312; occipito-nasal length, 310; palatal length, 169; zygomatic breadth, 207; interorbital breadth, 79.

URSUS HENSHAWI[1] MERRIAM.

HENSHAW GRIZZLY.

Ursus henshawi Merriam, Proc. Biol. Soc. Washington, XXVII, p. 190, August 13, 1914.

Type locality.—Southern Sierra Nevada, near Havilah, Kern County, California.

Type specimen.—No. 15671, ♂ old, U. S. National Museum. Collected in 1875 by Dr. J. T. Rothrock and Henry W. Henshaw.

Range.—Lower slopes of southern part of Sierra Nevada; limits unknown.

Characters.—Size rather small—by far the smallest of the California grizzlies; size and general cranial characters as in *horriæus*, but fronto-nasal region strongly dished and rostrum strongly depressed. Last upper molar short and broad, the heel short and subtriangular. Skin characters unknown.

Cranial characters.—*Old male* (type): Skull long, narrow, and rather low; zygomata subtriangular, narrowly spreading; frontal shield gently sloping, flat-concave; postorbital processes massive, and somewhat arched; orbital rims swollen; fronto-nasal region strongly depressed and dished; rostrum low, depressed.

Cranial comparisons.—Compared with an equally old male *horriæus* (type, from Coppermines, New Mexico): Surprisingly similar in general, with similar broad outstanding postorbitals, but rostrum strongly depressed; nasals flattened and horizontal anteriorly; fronto-nasal region concave and strongly dished (in *horriæus* rather high and not dished); frontal shield strongly and broadly concave between orbits and between postorbital processes (only faintly depressed medially in *horriæus*); more strongly sloping anteriorly; postorbital processes shorter and blunter; orbital rims more prominent, relatively thin, somewhat everted, continuing to lachrymal notch—their prominence anteriorly due in part to presence of a broad sulcus in ascending arm of maxillary immediately in front of orbit; lachrymal duct opening in orbit posterior to orbital rim (in *horriæus* on or anterior to rim); anterior nares broader than high (contrary true in *horriæus*); lambdoid crest higher; sagittal crest and inion much shorter; occipital overhang much less; palate decidedly broader; interpterygoid canal shorter; mastoid processes much longer and more divergent; anterior part of pterygoids more broadly expanded vertically and articulating with a like expansion of posterior arms of palatines (probably not constant). Upper molars decidedly broader (canines broken off).

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[1] Named for Henry W. Henshaw, formerly chief of the Biological Survey.

Compared with two old males of *tularensis* (type, No. 3536, and No. 3537, from Fort Tejon, California): Size smaller; occipitosphenoid length and frontal breadth essentially the same; vault of cranium and rostrum very much lower; fronto-nasal region more deeply concave, more strongly sloping, and strikingly more dished; rostrum smaller, lower, and strongly depressed instead of elevated; occipital overhang and development of inion conspicuously less; posterior part of sagittal crest not elevated or produced. Underjaw decidedly shorter, ramus much less broadly flattened vertically and more strongly bellied posteriorly. Last upper molar much smaller, the heel conspicuously shorter and narrowed on outer side.

Skull measurements.—Old male (type): Basal length, 318; occipito-nasal length, 305; palatal length, 173; zygomatic breadth, 204; interorbital breadth, 76.

Stikeenensis Group.

URSUS STIKEENENSIS MERRIAM.

STIKINE GRIZZLY.

(Pl. IX.)

Ursus stikeenensis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 178–179, August 13, 1914.

Type locality.—Tatletuey Lake, tributary to Finlay River, near head of Skeena River, northern British Columbia.

Type specimen.—No. 202794, ♂ ad., U. S. National Museum, Biological Survey collection. Collected September 23, 1913, by Charles R. Cross, jr., and Edward A. Preble; original No. 5772.

Range.—Region about head of Finlay River, and Dease Lake region, northern British Columbia, and northerly in Yukon.

Characters.—Adult male (type): Size medium; skull short, broad, and highly arched; face strongly pugged from abrupt rising of frontal region; claws short and strongly curved for a grizzly (longest 60 mm.—tips worn by digging), dark, marked with yellowish on tips and sides. Upper molars large. Total length before skinning 1,830 mm.; hind foot 267 mm.; estimated height at shoulder 990 mm. (39 inches).

Color.—Type specimen: General ground color dark brown, grizzled and washed with pale-tipped hairs. Muzzle pale brown, becoming darker between eyes and on sides of face; top of head in front of ears washed with yellowish brown, almost forming a golden brown band between the darker ungrizzled frontal region and the more whitish color of the neck; general ground color of body very dark, bountifully overlaid on neck and back by pale buffy-tipped hairs which give a whitish cast to the neck; ears dark; legs and feet blackish; underparts dark brown; hairs on sides of throat long and grizzly.

Cranial characters.—Adult male (type): Size medium or large; skull short posteriorly, broad, highly arched, strongly dished, with abruptly ascending frontals and large molar teeth. Rostrum short, broad, broadening and strongly ascending posteriorly; nasals strongly upturned posteriorly; frontal shield rather broad, rising abruptly and swollen in front of and above orbits, sulcate medially, short pointed, the point ending in sagittal crest about 30 mm. anterior to fronto-parietal suture; postorbital processes large, broad, subtriangular, and decurved (more broadly rounded and more outstanding in older skull); braincase long for size of skull; zygomata rather broadly spreading, subtriangular, not much expanded vertically; palate and postpalatal shelf broad. Underjaw and inferior border of ramus very short. Molars large and broad.

Cranial comparisons.—Adult male compared with adult male *absarokus*: Size nearly the same though *absarokus* appears the larger; basal length and frontal breadth approximately the same, but occipito-nasal length much greater in *absarokus*. In *stikeenensis* rostrum lower, flatter, and more nearly horizontal; frontal shield and posterior part of nasals rising much more abruptly; frontals much more swollen in front of upper part of orbits; point of shield much shorter (ending midway between plane of postorbitals and fronto-parietal suture, while in *absarokus* it reaches posteriorly to suture); inion short; palate broader; underjaw shorter; coronoid lower.

Adult male compared with adult male *tahltanicus* (both inhabiting the same region): Basal length, zygomatic breadth, and frontal breadth essentially the same, but frontal region much higher and rising abruptly at orbits instead of sloping gently in plane of rostrum; rostrum broader, flatter, and more nearly horizontal (appearing shorter); postorbitals much larger and less horizontally outstanding; palate longer; underjaw longer. Dentition heavier.

Skull measurements.—Adult male (type): Basal length, 321; occipito-nasal length, 305; palatal length, 171; zygomatic breadth, 217; interorbital breadth, 84.

URSUS CRASSODON SP. NOV.

BIG-TOOTH GRIZZLY.

Type No. 171049, ♂ old, U. S. National Museum, Biological Survey collection. Collected on Klappan Creek (=Third South Fork Stikine River), September, 1907, by Dr. E. P. Richardson, of Boston.

Cranial characters.—*Old male* (type): Frontal shield broad, lyrate posteriorly, the point reaching or slightly passing fronto-parietal suture; shield rising abruptly from rostrum, sulcate anteriorly but nearly flat between postorbitals; postorbitals broadly rounded and horizontally outstanding; rostrum of medium breadth, nearly horizontal; braincase short; sinus case rising to support postorbital part of shield; zygomata moderately outstanding, subtriangular, the squamosal root not broadly expanded; squamosal shelf narrow; palate and postpalatal shelf moderate; ramus short; coronoid blade rather small, moderately recurved at apex; canines rather large; *molars enormous* for size of skull; M^1 and M^2 very broad; heel of M^2 subtriangular, narrowing posteriorly.

I refer to this species two young males from Yukon, one (No. 209896) from White River, the other (No. 1839, Ottawa Museum) from Wolf Lake near Teslin Lake, both in the third year; and an old female (No. 202792) from Tatletuey Lake on the upper Finlay. Besides these, two very old male skulls from southern Yukon (No. 223760 from Glenlyon Mountains and No. 223767 from Quiet Lake at head of Big Salmon River) are provisionally referred to the species, but not without considerable hesitation. Both are high, short, and broad as in *crassodon*, but the teeth are too much worn to admit of reliable comparison. One (No. 223760) is so extremely aged that the roots of the canines have worked down and become absorbed basally, leaving the middle part of the rostrum narrower than normal.

Skull measurements.—Old male (type): Basal length, 320;[1] occipito-nasal length, 306;[1] palatal length, 175; zygomatic breadth, 222; interorbital breadth, 84.

URSUS CRASSUS SP. NOV.[2]

THICKSET GRIZZLY.

Type No. 225473, ♂ ad., U. S. National Museum, Biological Survey collection. From upper Macmillan River, Yukon. Collected in September, 1916, by William Drury.

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[1] Partly restored.

[2] Tentatively included in *stikeenensis* group. (See Introduction, pp. 12–18.)

Characters.—Size large; hump apparent but not conspicuous; general color dark; claws of medium length, narrow, moderately curved, smooth, whitish above, with dark sides.

Color.—Muzzle pale brownish; top of head and neck strongly washed with yellowish or golden buffy; shoulders and back lightly tipped with same on dark background; legs and feet dusky.

Cranial characters.—*Adult male* (type): Skull rather large, short, broad, rather high, but not highly arched, and unusually massive. Shield broad, convex, faintly sulcate, sloping gradually into rostrum, the point reaching fronto-parietal suture; postorbitals rather broad, decurved in convexity of shield; rostrum large and high, rising in plane of shield; sagittal crest short; zygomata moderate; palate narrow and strongly troughed; postpalatal shelf short; underjaw rather short, massive; coronoid blade high and nearly vertical; subangular border short. Teeth large; canines massive; M^2 very long, its heel exceptionally long and flat, slightly emarginate and everted.

Cranial comparisons.—The skull of the adult male (type) viewed from above bears a striking likeness to that of adult male *hoots*, but when turned over the likeness ceases. It agrees with *hoots* essentially in size, massiveness, arching of vault of cranium, and frontal breadth; but frontal shield is more convex; postorbitals more decurved; rostrum somewhat more ascending (higher posteriorly); orbital rims less swollen; palate decidedly narrower and troughed instead of flat; coronoid more nearly vertical; subangular border shorter; teeth strikingly larger throughout—incisors, canines, and molars. The teeth of *hoots* are small for size of skull, those of *crassus* exceptionally large.

Male adult (type) compared with male adult *crassodon* (type): Size slightly greater; frontal shield much broader, more gently sloping, and more convex transversely, with decurved postorbitals (in *crassodon* shield flattish, nearly horizontal, with horizontally outstanding postorbitals and descending abruptly to rostrum); rostrum very much larger and higher and sloping gradually into shield; ramus much longer; subangular border shorter; coronoid larger and higher. Upper canines about same; lower canines much larger; upper and lower molar series of about same length but upper molars much narrower and less massive.

Remarks.—The skull of an immature male (No. 6552) collected by R. MacFarlane, May 1, 1863, on Anderson River, 50 miles southeast of old Fort Anderson, has very large teeth, especially M^2, thus differing widely from any adult Barren Ground bear thus far examined. Two still younger skulls collected on the Barren Grounds in 1911, by Dr. R. M. Anderson (No. 34411 Amer. Mus. Nat. Hist. from Horton River, and 34413 from Langton Bay), also have the crown of M^2 very long. These three skulls I provisionally refer to *crassus*.

It is a singular fact, in view of the wide dissimilarity of the skulls, that the teeth of male *crassus* and male *kluane* are very much alike.

Skull measurements.—Adult male (type): Basal length, 325; occipito-nasal length, 322; palatal length, 171; zygomatic breadth, 224; interorbital breadth, 94.

URSUS MIRABILIS MERRIAM.[1]

STRANGE GRIZZLY.

Ursus mirabilis Merriam, Proc. Biol. Soc. Washington, XXIX, p. 146, September 6, 1916.

Type locality.—Admiralty Island, Alaska.

Type specimen.—No. 137471, ♂ ad., U. S. National Museum, Biological Survey collection. Collected June 26, 1905, by Cyrus Catt.

Characters.—A true grizzly, of medium size, related to *stikeenensis* of the mainland, and having the same high bulging forehead; external characters unknown.

Cranial characters.—*Adult male* (type): Skull of medium size, short, with rather broadly spreading zygomata and highly arched (almost domed) frontal region. Frontal shield of moderate breadth, short pointed posteriorly, rising abruptly from rostrum, convex both antero-posteriorly and transversely, slightly sulcate medially, moderately swollen on each side of sulcus; postorbital processes moderate, broader than peglike, slightly decurved (continuing convexity of frontals); fronto-nasal region strongly dished; rostrum high, narrow, strongly sloping; zygomata rather broadly outstanding, slightly bowed; palate and postpalatal shelf rather broad; underjaw short; ramus bellied posteriorly; coronoid blade high and rather vertical, the apex not reaching plane of condyle. Upper canines rather long; molars rather broad and short.

Cranial comparisons.—*Ursus mirabilis* requires comparison with only a single species—*stikeenensis* of the neighboring mainland: Size smaller; frontal shield narrower and more bulging anteriorly, rising more abruptly from rostrum; rostrum narrower, materially higher, and more sloping; zygomata more widely outstanding; occipital overhang more pronounced; palate and postpalatal shelf similar; underjaw less massive; coronoid blade narrower and higher; teeth similar, but heel of last upper molar much shorter.

Skull measurements.—Adult male (type): Basal length, 308; occipito-nasal length, 310; palatal length, 168; zygomatic breadth, 230; interorbital breadth, 81.

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[1] Tentatively included in *stikeenensis* group. (See Introduction, pp. 12–13.)

URSUS ABSAROKUS Merriam.[1]

Absaroka Grizzly.

Ursus absarokus Merriam, Proc. Biol. Soc. Washington, XXVII, p 181, August 13, 1914.

Type locality.—Near head of Little Bighorn River, northern part of Bighorn Mountains, Montana.

Type specimen.—No. 67391, ♂ ad., U. S. National Museum, Biological Survey collection. Collected in May, 1893; purchased for Biological Survey by J. Alden Loring.

Range.—Laramie and Bighorn Mountains, eastern Wyoming, Black Hills region, South Dakota, and northward along Little Missouri to Missouri and Yellowstone Rivers.

Characters.—Size large, but much less than *horribilis* and with much smaller molars—especially M^2.

Color.—Head of young-adult (No. 203524) killed by Howard Eaton on the Little Missouri at mouth of Bear Creek, near Middle or "Bullion" Butte, October 27, 1880: Muzzle pale brown, changing to grizzled dark brown on head and face; a large patch of dark brown free from grizzling on side of face extending from eye to angle of jaw; chin and gular region dark brown (except anterior part of chin, which has not yet molted the pale old coat); top and sides of neck and doubtless body also, strongly grizzled.

Cranial characters.—*Adult male* (type specimen, and other males from Bighorn and Laramie Mountains): Vault of cranium rather highly arched; zygomata moderately outstanding and slightly bowed; frontal shield rather broad, rising strongly from rostrum, convex both antero-posteriorly and transversely; slightly swollen on each side of median line just behind plane of orbits, faintly depressed medially between orbits; postorbital processes large, outstanding, and slightly decurved, the tips bluntly rounded; sagittal crest nearly straight, reaching anteriorly to fronto-parietal suture; rostrum large and high, rising strongly into frontal shield; postpalatal shelf broad and flat; nasals large and long; top of coronoid high and broadly rounded, its apex short, not reaching posteriorly to plane of condyle. Teeth rather large, especially M^2 which is long and broad, the heel emarginate on outer side.

Cranial comparisons.—Adult male (type) compared with adult male *shoshone* (type): Basal length essentially the same but skull somewhat larger and more massive, broader, highest point more anterior; frontal shield broader, domed (strongly convex both antero-posteriorly and transversely) and rising rather abruptly from plane of rostrum (in *shoshone* flat); point of shield much longer posteriorly, reaching to or nearly to fronto-parietal suture. Molars larger—especially M^2.

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[1] Tentatively included in *stikeenensis* group. (See Introduction, pp. 12–13.)

Skull measurements.—Adult male (type): Basal length, 322; occipito-nasal length, 322; palatal length, 172; zygomatic breadth, 218; interorbital breadth, 88.

Alascensis Group.

URSUS ALASCENSIS MERRIAM.

ALASKA GRIZZLY.

(Pl. XII.)

Ursus horribilis alascensis Merriam, Proc. Biol. Soc. Washington, X, pp. 74–75, April 13, 1896.

Type locality.—Unalaklik River, Alaska.

Type specimen.[1]—No. 76466, ♂ old, U. S. National Museum, Biological Survey collection. Collected in 1895, by the late Rudolf Neumann, of Iliuliuk, Alaska.

Range.—Norton Sound region, Alaska (Unalaklik and Shaktolik Hills) southerly over the Nushagak and Kuskokwim Rivers to Chinitna on Cook Inlet. Limits unknown.

Cranial characters.—*Old male* (type): Size small; braincase broad anteriorly; frontal shield rather broad, flattish, very short pointed posteriorly with correspondingly elongate sagittal crest, moderately sulcate interorbitally, otherwise convex in cross section, rising rather strongly from facial plane; postorbitals rather small, moderately decurved; fronto-nasal region moderately dished; zygomata subtriangular, not broadly outstanding; palate rather broad and concave; postpalatal shelf broad and short; notch rather broad; jaw rather long; inferior border of ramus long, moderately convex posteriorly; coronoid blade moderate, rather high, the apex recurved. Teeth moderate; last upper molar broad and short, with short obliquely truncate heel; first lower molar sinuous, a strong concavity on outer side.

Adult female:[2] Long and high; vault of cranium well arched, highest about midway of frontals; frontal shield rather narrow, not flattened but arching high above facial plane; swollen between median sulcus and orbits; postorbital processes decurved; palate and postpalatal shelf long. Last upper molar with short heel.

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[1] In describing this bear 20 years ago I neglected to designate a type, and the original material included skulls of more than one species. I take this opportunity therefore to fix the type of *Ursus alascensis* on one of the original specimens (No. 76466, U. S. National Museum, Biological Survey collection) and to redefine the species.

[2] In the absence of skulls of adult females from the type region it is assumed that females from the Nushagak, Kuskokwim, and Chinitna Rivers are fairly typical of *alascensis*.

Cranial comparisons.—Old male (type) compared with old male *toklat* (No. 158811, collected by Charles Sheldon at head of Toklat River near northern base of Mount McKinley): Size and general appearance essentially the same, but vault of cranium less elevated; frontal shield narrower and shorter (the point reaching about halfway from plane of postorbitals to parietals); sagittal crest longer; zygomata *much less broadly outstanding*, less arched; underjaw decidedly longer; inferior border of ramus longer; coronoid decidedly higher; heel of last upper molar *very much shorter*.

Adult female compared with adult female *toklat*: Skull decidedly larger; vault of cranium much higher and more arched (in *toklat* low and flat), highest about middle of frontals instead of at hinder end; rostrum larger (longer, broader, and higher); face more sloping (nasals less nearly horizontal); frontals much more swollen between sulcus and orbits; postorbital processes more decurved; palate, postpalatal shelf, and occipito-sphenoid notably longer; last upper molar very much shorter.

Adult male compared with adult male *tundrensis* of same region: Size smaller (basilar and occipito-nasal lengths fully an inch less); skull less massive; frontals narrower, rising more abruptly from facial plane and more swollen over orbits; rostrum more slender; palate less flattened; ramus of jaw less swollen posteriorly; coronoid less falcate; canines smaller, decidedly shorter, and more curved; molars decidedly smaller.

Skull measurements—Old male (type): Basal length, 310; occipito-nasal length, 298.5; palatal length, 166; zygomatic breadth, 206; interorbital breadth, 79.

URSUS TOKLAT MERRIAM.

TOKLAT GRIZZLY.

Ursus toklat Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 182–183, August 13, 1914.

Type locality.—Head of Toklat River, north base of Alaska Range, near Mount McKinley, Alaska.

Type specimen.—No. 158813, ♀ ad., U. S. National Museum, Biological Survey collection. Collected May 24, 1908, by Charles Sheldon, and by him presented to the Biological Survey; original No. 324. Mother of cub No. 158814 (original No. 325).

Range.—So far as known, restricted to Alaska Range.

Characters.—Size medium; skulls of both male and female rather highly arched and dished, that of female much smaller and lower than male. Last upper molar large; heel very long. Claws horny and smooth.

Color.—Color variable, upperparts ranging from ordinary "grizzly bear color" to creamy white; claws usually dark throughout, but in many cases more or less marked with white.

Cranial characters.—*Adult males:* Size medium; rostrum high, subterete above, nearly horizontal; frontal shield abruptly elevated, convex or domed, swollen over orbits, sulcate medially, rather long pointed (reaching fronto-parietal suture); postorbital processes rather small and strongly decurved; squamosal shelves short; palate arched and excavated longitudinally; postpalatal shelf rather broad; zygomata very broadly spreading and angular (zygomatic breadth in proportion to basal length much greater than in any other true grizzly, about equaling that of *sheldoni*); sagittal crest short. Last upper molar large, its heel normally very long. *Adult female:* Skull rather long and narrow, with broadly spreading zygomata and strongly dished fronto-nasal region; frontal shield rather flat, sulcate between orbits, varying from lyre pointed to short pointed; postorbital processes outstanding horizontally; rostrum rather slender, nearly horizontal. In most specimens the highest point of cranium culminates in a rather abrupt change of angle at or near the fronto-parietal suture, forming a sort of "hump," a condition usual also in skulls of female grizzlies from the upper Yukon and northern British Columbia.

Cranial comparisons.—Old male compared with old male *alascensis:* Frontal region more elevated; sagittal crest shorter; zygomatic breadth much greater; heel of last upper molar much longer.

Adult female compared with female *alascensis:* Size smaller; vault of cranium decidedly lower, highest over posterior part of frontals instead of over middle of frontals; frontal shield narrow, flattened, sloping (not arched and not materially swollen over orbits); postorbital processes outstanding horizontally; palate, postpalatal shelf, and occipito-sphenoid shorter; M^2 with heel much longer.

Adult female compared with adult female *phæonyx:* Size decidedly greater; teeth much larger, especially the canines and last upper molars.

Adult female compared with adult female *kluane:* Length much greater; facial part of skull about the same; braincase and postpalatal parts much longer; vault of cranium higher; sagittal crest longer and higher, reaching forward over posterior frontals; point of shield much shorter; underjaw and inferior border of ramus much longer; teeth about the same size but M^1 usually smaller; heel of M^2 longer.

Skull measurements.—Old male (No. 158811, from head Toklat River, Alaska): Basal length, 304; occipito-nasal length, 298; palatal length, 169.5; zygomatic breadth, 222; interorbital breadth, 80. Old female (type): Basal length, 283; occipito-nasal length, 267; palatal length, 157; zygomatic breadth, 187; interorbital breadth, 73.

URSUS LATIFRONS MERRIAM.

BROAD-FRONTED GRIZZLY.

Ursus phæonyx latifrons Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 183–184, August 13, 1914.

Type locality.—Jasper House, Alberta.

Type specimen.—No. 75612, ♂ old, U. S. National Museum, Biological Survey collection. Collected September 15, 1895, by J. Alden Loring. Original No. 3270.

Range.—Rocky Mountains of western Alberta and eastern British Columbia from Jasper House northwesterly to region between headwaters of Parsnip and Great Bend of Fraser River and thence to extreme headwaters of Stikine River; limits of range unknown.

Characters.—Size medium or rather large. External characters unknown. Affinities with the geographically remote *toklat.*

Cranial characters.—*Adult male* (type): Size medium; base elongate posteriorly; vault of cranium rather low, only slightly arched, top flattish; frontal shield very broad (interorbitally 93 mm., between tips of postorbitals 130), rising from rostrum rather abruptly, broadly but shallowly depressed medially, swollen over orbits, the point ending in sagittal crest some distance (apparently more than an inch) anterior to fronto-parietal suture; postorbital processes *broad*, outstanding, and only slightly depressed; fronto-nasal region slightly dished; rostrum rather high, nearly horizontal, rounded above; postpalatal shelf rather broad; notch rather narrow; zygomata strongly outbowed but not widely spreading; underjaw long; coronoid blade broad basally, rather low, its anterior border sloping strongly backward. Teeth too badly worn to admit of description. *Adult female* (No. 209378) collected by F. K. Vreeland, September 17, 1915, near head of Big Salmon or North Fork Fraser River between Big Bend of the Fraser and headwaters of the Parsnip: Similar in general to that of male with the usual sexual difference in frontal shield, which is lyrate pointed posteriorly; frontal shield broad—broadly depressed medially between orbits, swollen over orbits; postorbital processes strongly developed, outstanding, slightly decurved; sagittal crest short, high posteriorly, covering about three-quarters of suture between parietals; postpalatal shelf rather broad and flat; mastoids short and appressed; postpalatal notch short, of moderate breadth; zygomata moderately outstanding, less bowed than in the male; coronoid blade broad basally, rather low, recurved at apex; canines of medium size; molars large, especially last upper molar.

Cranial comparisons.—Old male (type) compared with old male *toklat* (from type locality): Frontal shield much broader and less elevated; braincase less arched; palate flatter (in *toklat* distinctly arched antero-posteriorly); zygomata more rounded basally and more *outbowed* (less angular); underjaw slightly longer; inferior border of ramus much longer; coronoid blade broader and higher. The basal part of the skull is longer in *latifrons* than in *toklat*. This is apparent whether the skull is viewed from above or below. In *latifrons*, seen from above, the distance from occipital crest to postorbital process is materially greater; while seen from below, the distance from occipital condyle to postpalatal notch is likewise greater. Another difference appears rather strikingly when the skull is viewed from below: in *latifrons* the squamosal base of the zygoma slopes gradually forward, while in *toklat* the curve is much shorter and more abrupt, so that the bases of the zygomata stand out much more squarely, practically at right angles to cranial axis.

While skulls of adult male *latifrons* differ strikingly from those of male *toklat*, skulls of the adult females are surprisingly alike, agreeing in general appearance, basal length, breadth of palate, and large size of last upper molar, though in *latifrons* this tooth is actually broader than in most specimens of *toklat*. The two agree essentially also in lower molars and canines. The underjaw in *latifrons*, however, is shorter, and coronoid blade lower than in *toklat*.

Old male compared with old male *kluane:* Frontal region much broader and flatter; postorbital processes much less decurved; sagittal crest shorter and straight instead of arched; rostrum less elevated and less narrowly rounded above; nasals flatter; zygomata more widely spreading and more strongly outbowed posteriorly; coronoid blade broader at base.

Adult female compared with adult female *kluane:* Skull much larger, longer, and more massive; frontal shield *much broader;* vault of cranium flatter (less arched over posterior frontals); rostrum higher; zygomata more widely outstanding; palate much broader; last upper molar much larger; lower molars and canines approximately same size. While the skull of female *latifrons* is much larger than that of female *kluane*, the underjaw is only slightly larger.

Adult female compared with adult female *phæonyx*: Size much larger; frontal region much broader; rostrum broader; nasals more nearly horizontal; arch of cranium more depressed; underjaw longer; coronoid blade broader; molars much larger. (Comparison of males is unnecessary, the male of *phæonyx* having a large, broad, massive skull resembling that of *dalli*.)

Skull measurements.—Old male (type): Basal length, 324; occipito-nasal length, 312; palatal length, 173; zygomatic breadth, 214.5; interorbital breadth, 94.

Richardsoni Group.

URSUS RICHARDSONI Swainson.

Barren Ground Bear.

Ursus Richardsoni Swainson, Animals in Menageries, pp. 54–56, 1838.

Type locality.—Shore of Arctic Ocean, on west side of Bathurst Inlet near mouth of Hood River.[1]

Characters.—Size medium; color variable, from yellowish to grizzly brown; foreclaws of medium length, smooth; skull medium or small, with broadly spreading zygomata.

Cranial characters.—*Adult males:* Two adult or rather old male skulls collected by Dr. R. M. Anderson in 1915, and loaned me by the Museum of the Geological Survey of Canada, at Ottawa (one No. 2774 from Dolphin and Union Straits, the other No. 2776 from near mouth of Coppermine River), are assumed to be typical: Size medium; cranium high in relation to size, but not much arched; basicranium flat; shield rising abruptly from rostrum, of medium breadth, broadly and strongly sulcate medially, swollen over orbits, short pointed; postorbital processes massive, outstanding, arched over orbits and slightly decurved; orbits nearly vertical; rostrum moderate, rather high and narrow, sloping into sulcus of shield; orbits prominent, rising well above fronto-nasal plane; zygomata moderate, somewhat outbowed; nares subrectangular, broader than high; palate rather short; postpalatal shelf moderate or rather broad; squamosal shelf weak posteriorly; underjaw rather short; infra-angular border of ramus short; apex of coronoid only slightly recurved, falling short of plane of condyle; angular process projecting beyond condyle. Teeth medium; canines rather large; M^2 with moderate heel, narrowing posteriorly; cusps of posterior molars weak, those of inner side of M^2 nearly obsolete (in striking contrast with the highly developed cusps of both upper and lower molars of *pellyensis*).

An exceedingly old male in the National Museum (No. 6255), collected on Anderson River by R. MacFarlane, has the shield less swollen over and in front of orbits, and even shorter pointed posteriorly; rostrum more depressed; sagittal crest longer and somewhat higher (but still not high) and somewhat humped over posterior frontals; zygomata more broadly outstanding.

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[1] Swainson's description was based on and largely quoted from Richardson's account of "an old and lean male, killed on the shores of the Arctic Sea on the 1st of August, 1821." (Article on the Barren Ground Bear, in Fauna Boreali-Americana, pp. 21–24, 1829.) And in Franklin's "Narrative of a Journey to the Shores of the Polar Sea," p. 373, 1823, under date of August 1, 1821, the party being at the mouth of Hood River on Bathurst Inlet, the killing of a lean male brown bear is chronicled in some detail. It appears therefore that the type locality of *Ursus richardsoni* is Hood River, Bathurst Inlet.

Skull measurements.—Old male (No. 6255) from Anderson River: Basal length, 311; occipito-nasal length, 286; palatal length, 163; zygomatic breadth, 227; interorbital breadth, 72.5. Old male (No. 2774, Ottawa Museum) from Dolphin and Union Strait: Basal length, 316; occipito-nasal length, 290; palatal length, 170; zygomatic breadth, 211; interorbital breadth, 79. Adult male (No. 2776, Ottawa Museum) from near mouth Coppermine River: Basal length, 299; occipito-nasal length, 288; palatal length, 163; zygomatic breadth, 217; interorbital breadth, 82.5.

URSUS RUSSELLI[1] MERRIAM.[2]

MACKENZIE DELTA GRIZZLY.

Ursus russelli Merriam, Proc. Biol. Soc. Washington, XXVII, p. 178, August 13, 1914.

Type locality.—West side Mackenzie River delta, Canada.

Type specimen.—No. 21301, ♂ old, University of Iowa Museum. Collected June 28, 1894, by Frank Russell. Mounted skin with skull separate.

Range.—Lower Mackenzie region; limits unknown.

Characters.—Size rather small. Color a curious pale drab-brown, somewhat darker on legs and feet; ears conspicuously hairy. Claws smooth, moderately to strongly curved; brownish horn color with paler (almost amber) tips. Teeth large; last upper molar of great size and peculiar glassy texture in type skull. Affinities uncertain.

Cranial characters.—*Adult male* (type): Skull of medium size, about equaling old male of *alascensis;* rather short; fairly broad across zygomata; frontal shield sloping strongly upward, moderately sulcate, swollen over orbits, but orbits not everted; posterior point of shield rather short, ending about one-third the distance from fronto-parietal suture to postorbital processes; postorbital processes peglike, standing out nearly horizontally—not depressed as in *alascensis;* muzzle rather narrow and high; zygomata slender, the posterior roots not expanded vertically; palate flat, not excavated or arched as in several species; underjaw massive, heavier under $M_{\overline{2}}$ and $M_{\overline{3}}$ than in *alascensis;* coronoid blade falcate but not narrowly so.

Cranial comparisons.—From *richardsoni*, its neighbor on the east, with which it agrees in size and in certain dental characters, it differs in much more highly vaulted cranium; more highly sloping (less nearly horizontal) braincase; much more elevated frontal region, and very much narrower rostrum. The frontal shield is much longer than in *richardsoni*, the temporal impressions curving backward to meet one another about one-third the distance between postorbital processes and fronto-parietal suture, instead of turning abruptly inward; postorbital processes more slender than in *richardsoni;* sagittal crest shorter and less nearly horizontal; upper molars *very much larger*, particularly broader. Zygomatic arches bowed outward in both species—not sharply angular as in many large bears.

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[1] Named for Frank Russell, who collected the type specimen.

[2] Tentatively included in *richardsoni* group. (See Introduction, pp. 12–13.)

Skull measurements.—Old male (type): Basal length, 310; occipito-nasal length, 300; palatal length, 163; zygomatic breadth, 220; interorbital breadth, 79.5.

URSUS PHÆONYX MERRIAM.

TANANA GRIZZLY.

Ursus horribilis phæonyx Merriam, Proc. Biol. Soc. Washington. XVII, p. 154, October 6, 1904.

Type locality.—Glacier Mountain, Tanana Mountains, Alaska (about 2 miles below source of Comet Creek, near Fortymile Creek, between Yukon and Tanana Rivers).

Type specimen.—No. 133231, ♀ ad., U. S. National Museum, Biological Survey collection. Collected July 12, 1903, by W. H. Osgood.

Range.—Tanana Mountains between Tanana and Yukon Rivers.

Characters.—Size of male large; of female small (sexual disparity great, much greater than in *dalli*).

Color.—Upperparts varying from creamy or buffy to dark "grizzly color"; underparts and muzzle pale brown; legs very dark brown, varying to blackish brown; claws horny and smooth, usually dark but sometimes marked with whitish. Last upper molar of medium size or rather small.

Cranial characters.—Old male (No. 201586, from Ketchumstock, assumed to be typical of *phæonyx*): Size medium or rather large; skull broad and short, moderately arched and dished, with broadly outstanding zygomata and rather deeply sulcate strongly sloping frontal shield. Frontal shield of moderate breadth, strongly swollen over orbits and bases of postorbitals, short pointed posteriorly, the point ending midway between fronto-parietal suture and plane of postorbitals; postorbitals triangular, broad basally, convex posteriorly, straight or concave anteriorly; rostrum moderate, nearly horizontal, sulcate-depressed on top; fronto-nasal region distinctly dished; squamosal shelves broad and rather short, the outer margin arched and upturned; middle part of zygomata moderately expanded vertically; palate broad and short; postpalatal shelf broad; notch relatively narrow. Underjaw long for size of skull, massive;

coronoid blade high, rather narrow, and rather vertical, the recurved apex not reaching plane of condyle. Teeth medium.

Adult female (type): Size small; vault of cranium well arched posteriorly, highest point 25 to 30 mm. in front of fronto-parietal suture; braincase rather broad, not much constricted anteriorly, not compressed, and with no tendency to keel into anterior part of sagittal crest; frontal shield moderately flattened, shallowly sulcate medially and slightly swollen on each side of median depression, gently sloping into rostrum posteriorly, the lyrate point reaching nearly to parietals; rostrum rather small; zygomata moderately outstanding; palate medium; postpalatal shelf rather broad and short. Underjaw long; inferior border of ramus long and straight; coronoids rather small, the apex strongly recurved, cutting plane of condyle.

Cranial comparisons.—Old female (type) compared with adult female *kluane:* Size somewhat larger; braincase broader anteriorly; frontal shield broader; palate and postpalatal shelf broader; occipito-sphenoid and postpalatal lengths much greater. Underjaw much longer; inferior border of ramus longer and straighter. Teeth too badly worn to admit of description but apparently about same size as in *kluane.*

Old female (type) compared with adult female *toklat* from Alaska Range, near Mount McKinley: Basal length somewhat less; braincase less contracted and much broader anteriorly (not compressed and with no tendency to keel into anterior part of sagittal crest); frontal shield less deeply sulcate anteriorly and much longer pointed posteriorly; fronto-nasal region less depressed; underjaw shorter; ramus straighter and lighter; coronoid much smaller, narrower, and lower; upper canines apparently about the same; last upper molar smaller; lower canines more slender; lower molars apparently about the same, but so completely worn off in type specimen that comparison is impossible.

Remarks.—The skull of the adult male *phæonyx* (if the sexes are correctly mated) is large, broad, and rather massive, requiring comparison with only a single known species, *Ursus dalli.* The female on the other hand is small and resembles in a general way the females of the still smaller *kluane*, *pulchellus*, and *pallasi.*

Skull measurements.—Old male (No. 205186, from Ketchumstock, Alaska): Basal length, 327; occipito-nasal length, 309; palatal length, 176; zygomatic breadth, 242; interorbital breadth, 85. Old female (type): Basal length, 280; occipito-nasal length, 267; palatal length, 148; zygomatic breadth, 189; interorbital breadth, 68.

URSUS INTERNATIONALIS MERRIAM.

ALASKA BOUNDARY GRIZZLY.

Ursus internationalis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 177–178, August 13, 1914.

Type locality.—Alaska-Yukon Boundary, about 50 miles south of Arctic coast (lat. 69° 00′ 30″).

Type specimen.—No. 1763, ♂ ad., Ottawa Museum. Killed July 3, 1912, by Frederick Lambart, of Canadian Boundary Survey.

Range.—Region bordering Arctic coast along international boundary, and doubtless adjacent mountains, between the coast and the Yukon-Porcupine; limits unknown.

Characters.—Size medium or rather large; affinities doubtful. Color a peculiar pale yellowish brown. Head strongly arched; muzzle and frontal region broad. Large lower premolar strictly conical, without heel, as in the brown bears.

Cranial characters.—Skull of medium size, massive, strongly arched and dished, highest over anterior part of braincase; frontal shield broad, very short pointed posteriorly, sulcate medially and swollen over orbits; postorbitals bluntly rounded, strongly decurved, not widely projecting; fronto-nasal region strongly dished; rostrum large and broad; sagittal crest long but feebly developed; zygomata subtriangular, not widely outstanding, and not much expanded vertically; palate and postpalatal shelf rather broad; notch moderate. Teeth rather small for size of skull; heel of last upper molar small and obliquely truncate on outer side; large lower premolar strictly of brown-bear type—a single cone without heel, sulcus, or posterior cusplets; first lower molar broad and somewhat sinuous; middle lower molar narrow and short posteriorly.

Skull measurements.—Adult male (type): Basal length, 309; occipito-nasal length, 293; palatal length, 169; zygomatic breadth, 203.5; interorbital breadth, 82.

URSUS OPHRUS[1] MERRIAM.

HIGH-BROW GRIZZLY.

(Pl. X.)

Ursus ophrus Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 148–149, September 6, 1916.

Type locality.—Eastern British Columbia (exact locality unknown).

Type specimen.—No. 210252, ♂ old, U. S. National Museum, Biological Survey collection. Collected in 1915, by E. W. Darbey.

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[1] *Ophrus*, with reference to the unusual brows.

Cranial characters.—Skull short, strongly dished, remarkably high, the deeply sulcate frontal shield rising abruptly high over orbits, with thickened brows and large outstanding arched postorbital processes. Frontal shield of moderate breadth; deeply and broadly concave between orbits, swollen over orbits and passing out into strongly outstanding postorbitals, short pointed posteriorly; fronto-nasal region deeply sulcate; middle part of nasals flat; sagittal crest high and reaching anteriorly nearly midway from fronto-parietal suture to plane of postorbitals; rostrum rather small and narrow; palate rather narrow; postpalatal shelf rather broad; zygomata broadly and strongly outbowed; mastoids rather long. Underjaw long, its inferior margin rather long and nearly straight; subangular tubercle considerably posterior to inferior dental foramen; coronoid blade broad, its apex only moderately recurved, ending anterior to plane of condyle; canines of medium size, the lower ones rather massive; molars of medium size, the upper rather small for size of skull.

Skull measurements.—Old male (type): Basal length, 323;[1] occipito-nasal length, 304; palatal length, 175; zygomatic breadth, 229; interorbital breadth, 85.

URSUS WASHAKE MERRIAM.

WASHAKIE GRIZZLY.

Ursus washake Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 152–154, September 6, 1916.

Type locality.—North Fork Shoshone River, Absaroka Mountains, western Wyoming (between Bighorn Basin and Yellowstone National Park).

Type specimen.—No. 213005, ♂ ad., U. S. National Museum, Biological Survey collection. Killed September, 1913, by Col. J. A. McGuire.

Cranial characters.—*Old male* (type): Size medium, about equaling male *shoshone* and male *horriæus;* skull rather short and high, moderately arched, with broad, elevated postorbitals and rather broadly outbowed zygomata. Frontal shield rather narrow, sloping strongly upward anteriorly, highest at postorbital processes, horizontal posteriorly, broadly concave between postorbital processes; postorbital processes large, broad, subtriangular as viewed from above, outstanding, elevated and slightly arched, rising well above frontal plane and passing anteriorly into thickened orbital rims; fronto-nasal region dished (change of angle about middle of nasals); rostrum rather small, strongly compressed horizontally between nasals and roots of canines, making nasals appear elevated; anterior nares small; zygomata rather slender, broadly spreading, rounded and strongly outbowed posteriorly, only slightly expanded vertically; sagittal crest low; postpalatal shelf broad, flat, and rather short; occipito-sphenoid 87 mm. (=distance from front of canine to or slightly beyond middle of M^1). Underjaw moderate; ramus bellied posteriorly; coronoid blade high and rather falcate, the apex cutting plane of condyle (line from apex to tip of angular process passing well behind condyle). Teeth moderate or rather large; M^2 large.

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[1] Restored.

Cranial comparisons.—Old male (type) compared with adult male *ophrus* (type): Size about the same, but appearing smaller; frontal shield less elevated and less deeply concave; fronto-nasal region elevated instead of sulcate-dished; zygomata less widely outbowed; postorbitals much broader and less elevated; orbital rims less swollen; postpalatal shelf shorter and broader; mastoids shorter; nares smaller and lower. Underjaw more massive; inferior border of ramus more swollen and much more bellied posteriorly; coronoid blade higher and more falcate, the apex reaching much farther posteriorly (cutting plane of hinder part of condyle).

Compared with adult male *canadensis* (type), to which it is not related but with which it agrees essentially in basal and occipito-sphenoid length: Frontal shield less flat, more elevated laterally, highest at postorbitals instead of at posterior point; fronto-nasal region more dished; rostrum smaller, narrower basally, more strongly compressed below nasals; postorbital processes very much larger, broader, and more massive, elevated, arched, and subtriangular, instead of slender and narrowly peglike; zygomata more outbowed and arched; sagittal crest low and straight instead of high and arched; inion less developed; braincase anteriorly broader and more depressed—not tending to "keel" into sagittal crest as in *canadensis;* occipito-nasal length less, although basal length of skull is essentially the same in both. Underjaw longer; inferior border of ramus shorter and more strongly bellied; coronoid blade higher and more falcate, its apex reaching farther posteriorly; distance from angle to subangular process much greater; diastema in both jaws much longer. Last upper and middle lower molars not quite so broad.

Compared with adult male *absarokus* (type): Size smaller; vault of cranium decidedly lower; braincase anteriorly broadly depressed; frontal shield narrower, lower, and flatter, concave instead of convex between postorbital processes; postorbital processes (viewed from above) *broadly triangular, uplifted, and somewhat arched* instead of pegshape; orbital rims more thickened and elevated; rostrum smaller, lower, more slender, and much more compressed horizontally between nasals and roots of canines, making the nasals appear elevated; sagittal crest lower; occipito-sphenoid shorter; occiput lower; anterior nares smaller. Underjaw shorter; inferior border of ramus much shorter; coronoid blade more falcate, its apex reaching farther posteriorly; angular process more slender and more produced posteriorly (line connecting apex of coronoid with angle passing well behind condyle—in *absarokus* cutting condyle near middle). Molars smaller.

Skull measurements.—Adult male (type): Basal length, 310; occipito-nasal length, 305; palatal length, 170; zygomatic breadth, 217; interorbital breadth, 76.

Kidderi Group.

URSUS KIDDERI KIDDERI[1] MERRIAM.

KIDDER BEAR.

(Pl. VIII.)

Ursus kidderi Merriam, Proc. Biol. Soc. Washington, XV, p. 78, March 22, 1902.

Type locality.—Chinitna Bay, Cook Inlet, Alaska.

Type specimen.—No. 116562, ♂ young (not fully grown), U. S. National Museum, Biological Survey collection. Collected June 9, 1901, by James H. Kidder.

Range.—Alaska Peninsula for its entire length.

Characters.—Size medium—small compared with *gyas* of the same region; sexual disparity small, female nearly as large as male; skull of adult male hardly half the bulk of male *gyas;* skull of adult female nearly the same size as that of female *gyas;* color yellowish brown; claws rather short, blue-black.

Color.—June specimens (in left-over winter pelage): General color yellowish brown, darkest on belly and legs, legs much darker than body. Most of the Kidder bears in the National Zoological Park are pale buffy yellowish, or yellowish cream color.

Cranial characters.—Adult male: Skull long, rather low, narrow, and massive; frontal shield narrow, moderately sloping; swollen over orbits and rather deeply sulcate or troughed medially; frontonasal region slightly dished; rostrum and nasals high and rather long; postorbital processes peglike, outstanding; braincase elongate; zygomata angular, only moderately spreading; sagittal crest long; palate long; mastoids long; underjaw long, with long ramus and moderate or low coronoid blade. *Adult female:* Skull in general like that of male but slightly smaller and with more slender rostrum and slightly smaller teeth. The sagittal crest extends much farther forward than in the females of most species, in this respect also resembling the male. The sexual difference in size of teeth appears to be covered by individual variation.

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[1] Named for James H. Kidder, who collected and presented the type specimen.

Cranial comparisons.—Adult male and female compared with adult female *gyas:* Adult males require no comparison, owing to the great difference in size of skull and teeth, but with the females the case is very different, the size being essentially the same. In *fully adult* females *kidderi* is easily distinguished by the *lowness* of the vault of the cranium and *greater length of the sagittal crest*—female *gyas* being rather highly domed and having the short sagittal crest of most female bears.

Males of *kidderi* are sometimes hard to tell from females of *gyas*, but in the case of fully adult skulls they may be distinguished as follows: Male *kidderi* averages longer, both in basal and occipitonasal length, is much less highly arched, and is more obliquely truncate posteriorly so that the occiput overhangs, giving the effect of a longer braincase. The rostrum also is somewhat longer. The frontal shield is quite different, being very much shorter posteriorly, ending about an inch in *front* of the parietals, whereas in female *gyas* the posterior point of the shield extends posteriorly to about the same distance *behind* the fronto-parietal suture. Thus in adult male *kidderi* the frontal shield is horizontal or *slopes forward* from its most posterior point, while in adult female *gyas* it *slopes backward* for some distance—from a point at least an inch in front of the fronto-parietal suture—the shield thus overreaching the highest point of the arch of the skull and sloping downward in both directions. The occipito-sphenoid length is slightly greater in female *gyas* than in male *kidderi*.

Comparison of cubs of the second, third, and fourth years: Cubs of *kidderi* after the molars are in position and the permanent canines partly exposed, are easily told from those of male *gyas* of corresponding age by the relatively small size of the teeth, especially the canines, molars, and outer upper incisors. It is not so easy, however, to tell them from female *gyas*, and in some cases it may be impossible. The most constant character appears to be the *length of the canines*, and this can not be determined in cubs less than three or three and a half years of age. The canines are slightly longer in male *kidderi* than in female *gyas*, and their diameter also is usually, but not always, greater. As a rule, also, the crowns of the molars are larger, especially longer, in male *kidderi* the combined length of the first and second lower molars averaging about 4 mm. greater than in female *gyas*. As the teeth become worn with use the differences become less and less obvious, so that after the third year the distinctions are not easy of recognition.

Skull measurements.—Average of 3 males from Belkofski, Alaska Peninsula: Basal length, 330; occipito-nasal length, 312; palatal length, 177; zygomatic breadth, 207; interorbital breadth, 74.

Average of 4 females from Pavlof Bay, Alaska Peninsula: Basal length, 330; occipito-nasal length, 312; palatal length, 181.5; zygomatic breadth, 218; interorbital breadth, 80.5.

URSUS KIDDERI TUNDRENSIS MERRIAM.

TUNDRA BEAR.

Ursus kidderi tundrensis Merriam, Proc. Biol. Soc. Washington, XXVII, p. 196, August 13, 1914.

Type locality.—Shaktolik River, Norton Sound, Alaska.

Type specimen.—No. 76470, ♂ ad., U. S. National Museum, Biological Survey collection. Collected by natives, September, 1894, and secured through the late Rudolf Neumann, then of Iliuliuk, Unalaska.

Range.—Tundra region of northwestern Alaska from Shaktolik River on Norton Sound, southerly across the lower Yukon, Kuskokwim, and Nushagak Rivers to Bristol Bay and north side of base of Alaska Peninsula.

Characters.—Size medium (small in contrast with *gyas*), about equaling *kidderi*. External characters unknown, but doubtless little different from *kidderi*. Known to the natives as "Red Bear."

Cranial characters.—Size medium, about as in *kidderi;* skull rather long and heavy; frontals broad and flat, broadly but not deeply sulcate medially; postorbital processes small; coronoid blade falcate and rather high.

Cranial comparisons.—Similar to *kidderi* in essential cranial and dental characters, but differing in having the frontal shield and postorbital processes *very much broader and flatter*, and the frontal sulcus less marked. As in *kidderi* there is little difference in the sexes except that the females have narrower muzzles and narrower frontal shields. A young male (No. 16375) from Andreafski on the lower Yukon, collected by E. W. Nelson, has somewhat shorter canines than the others.

From *alascensis*, the grizzly of the same general region, skulls of *tundrensis* (adult males in both cases) may be distinguished by the following characters: Size larger (basilar and occipito-nasal lengths fully an inch greater); skull as a whole much more massive; frontals broader, rising less abruptly from facial plane, less swollen over orbits; rostrum less slender; palate more flat; ramus of jaw thicker under $M_{\overline{2}}$ and $M_{\overline{3}}$; coronoid blade more falcate; canines larger, decidedly longer, and somewhat less curved; molars decidedly larger.

Skull measurements.—Adult male (type): Basal length, 333; occipito-nasal length, 317; palatal length, 178; zygomatic breadth, 228; interorbital breadth, 93.

URSUS EXIMIUS Merriam.

Knik Bear.

Ursus eximius Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 139–140, September 6, 1916.

Type locality.—Head of Knik Arm, Cook Inlet, Alaska.

Type specimen.—No. 122495, ♂ ad., U. S. National Museum. Collected by G. W. Palmer.

Characters.—Size rather large; color uniform rich dark brown suggesting seal brown; muzzle brown, paler than rest of head; back of head and neck lightly sprinkled with pale-tipped hairs; claws of medium thickness, only slightly curved, decidedly short, probably from wear, smooth, very dark horn color, becoming paler on sides toward tip. Skull long and narrow, with narrow highly arched frontals. Related to *kidderi*.

Cranial characters.—Adult male (type): Skull long, extremely narrow in fronto-nasal region, rather highly arched and strongly dished. Frontal shield exceedingly narrow, convex, shallowly sulcate medially, strongly arched anteriorly, horizontal posteriorly, long-pointed, the point nearly reaching fronto-parietal suture; postorbital processes slender, peglike, moderately outstanding; fronto-nasal region strongly dished; rostrum long, narrow, high, compressed between nasals and canine roots; zygomata moderately outstanding, subtriangular; palate long and narrow; postpalatal shelf relatively broad; notch rather broad; mastoids long, strongly divergent; underjaw long, moderately massive, the ramus broad vertically; coronoid blade rather broad, the apex not strongly recurved; teeth of medium size; M^2 with rather long heel, not much narrowed posteriorly; M^1 relatively large and broad; $PM_{\overline{4}}$ a single cone without distinct heel but sulcate posteriorly.

Adult female (No. 205176, from type locality): Skull long and narrow; vault of cranium moderately arched, the highest part forming a hump at fronto-parietal suture; frontal shield narrow, flattish, sulcate medially, the point reaching fronto-parietal suture; postorbitals weak, subtriangular, not decurved; fronto-nasal region moderately dished; rostrum narrow, compressed between nasals and canine roots; zygomata moderately spreading, subtriangular; postpalatal shelf relatively broad; notch moderate; inferior border of ramus convex from plane of front molar posteriorly; coronoid blade broad and low.

Cranial comparisons.—Ursus eximius appears to be related to only a single species, *kidderi* of Alaska Peninsula. Adult male (type) compared with a series of *kidderi* from various points on Alaska Peninsula: Size about the same; vault of cranium more highly arched; frontal shield narrower, more strongly convex in cross section, less deeply sulcate; postpalatal processes more slender, peglike, and outstanding; fronto-nasal region more dished; rostrum more slender; nasals longer posteriorly, more completely wedge-shaped, reaching posteriorly to plane of postpalatal processes; mastoids longer and more divergent.

Adult female (No. 205176, from head of Knik Arm) compared with adult female *kidderi:* Size materially smaller; frontal shield and rostrum much narrower; vault of cranium notably higher over fronto-parietal suture; braincase narrower; nasals longer posteriorly; underjaw smaller and lighter.

Adult male (type) compared with adult male *alascensis* (No. 76466, from Unalaklik River, Norton Sound, Alaska): Skull much longer, more highly arched, and narrower throughout. Frontal shield much more elevated, narrower, and longer posteriorly; fronto-nasal region more strongly dished; rostrum narrower and higher; lambdoid crest more strongly developed; palate and postpalatal shelf much longer; occipito-sphenoid much longer; mastoids much longer and strongly divergent; underjaw longer; coronoid blade much higher; teeth larger; heel of M^2 much longer.

Adult female compared with female *alascensis:* Length essentially the same; skull narrower throughout; frontal shield lower, much narrower and flatter, rising less abruptly from rostrum; fronto-nasal region sulcate but less strongly dished; rostrum slightly more slender; postpalatal shelf narrower. Underjaw about same length; inferior border of ramus more evenly convex (less abruptly bellied); coronoid blade broader; canines about same size; molars somewhat larger.

Skull measurements.—Adult male (type): Basal length, 331; occipito-nasal length, 319; palatal length, 185; zygomatic breadth, 215; interorbital breadth, 71.

Innuitus Group.

URSUS INNUITUS MERRIAM.

INNUIT BEAR.

(Pl. VII.)

Ursus innuitus Merriam, Proc. Biol. Soc. Washington, XXVII, p. 177, August 18, 1914.

Type locality.—Golofnin Bay, south side of Seward Peninsula, northwestern Alaska.

Type specimen.—No. 179780, ♂ old, U. S. National Museum, Biological Survey collection. Collected in 1886, by Edward F. Ball.

Range.—Coastal region of Norton Sound, Alaska, from Unalaklik northward and westward; limits unknown.

Characters.—Size large; external characters unknown. Molars large and massive, especially M^2. Large lower premolar subconical, apparently of the brown bear type. But in the north the grizzly type of premolar often fails in true grizzlies; hence not having seen the claws, it is at present impossible to say whether *innuitus* is a brown bear or a grizzly.

Cranial characters.—Old male (type): Skull large; basal length essentially the same as in *horribilis* and *alexandræ* but occipito-nasal length much less, owing to shortness of occiput; fronto-nasal region strikingly dished; rostrum short, exceedingly broad (of same breadth as in *alexandræ*, very much broader than in *horribilis*), strongly depressed; frontal shield exceedingly broad interorbitally, rising high and abruptly from rostrum, nearly horizontal behind plane of postorbital processes, rather deeply sulcate medially and strongly swollen over orbits; postorbital processes large, subtriangular, outstanding and decurved; nasals nearly horizontal; palate and postpalatal shelf broad; postpalatal notch of medium width; zygomata broadly spreading and somewhat outbowed posteriorly, acute anteriorly; nares broader than high; sagittal crest short, extending only about 25 mm. beyond fronto-parietal suture, straight (not arched), high posteriorly; lambdoid crest large and full; coronoid blade narrow and high; ramus long and flat. Canines badly broken, apparently long; last lower premolar broad, broader posteriorly than anteriorly, the cusp small and sloping posteriorly without heel or marginal cusplets, but with pit and indication of narrow sulcus; molars exceptionally large and broad, the last upper one with heel strikingly long and broad, agreeing almost exactly with that of true *horribilis* from eastern Montana.

Two youngish skulls from Unalaklik (No. 82024, third year and No. 210554, fourth year) are believed to be females of this species. They are not old enough to show adult cranial characters except that the postpalatal shelf is broad and flat and the notch broad, but the teeth are perfect, full grown, and unworn. Canines of medium size (in the type badly broken and hence not available for comparison); molars large but smaller and less massive than those of type; M^2 large, cusps on inner side nearly obsolete (presenting little more than an undulating line), heel long and broad with large flat granular grinding surface.

Cranial comparisons.—The only species needing comparison with *innuitus* are *alexandræ* and *cressonus*. The old male skull resembles certain old skulls of *alexandræ* from Kenai Peninsula, but differs rather strikingly in truncation of occiput (the occipital overhang being very much less) and corresponding shortening of braincase and sagittal crest. The crest moreover is straight instead of arcuate or arched, and the molars, especially M^1 and M^2 are very much larger.

Compared with old male *cressonus* (type): Basal length and zygomatic breadth essentially same; occipito-nasal length much less; frontal shield broader, much less elevated over orbits; rostrum much broader and lower; occipital overhang much less; braincase and sagittal crest much shorter; postpalatal shelf broader and flatter.

Skull measurements.—Old male (type): Basal length, 353; occipito-nasal length, 331; palatal length, 194; zygomatic breadth, 251; interorbital breadth, 104.

URSUS CRESSONUS MERRIAM.

CHITINA BEAR.

Ursus cressonus Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 187–189, September 6, 1916.

Type locality.—Lakina River, south slope of Wrangell Range, Alaska.

Type specimen.—No. 206529, ♂ old, U. S. National Museum, Biological Survey collection. Collected by Captain J. P. Hubrick, of McCarthy, Alaska, 1914.

Range.—Chitina River valley and adjacent slopes of Skolai and Wrangell Mountains, westerly doubtless through Chugach Mountains to the west side of Cook Inlet; occurs as far south as the Iliamna region.

Cranial characters.—Old male (type): Skull peculiar and distinctive; size large (basal length 357 mm.); skull long, narrow, high, and strongly dished; frontal shield highly elevated, rising abruptly from rostrum, rather broad, deeply sulcate throughout medially, swollen over orbits, short pointed posteriorly; orbits nearly vertical; postorbital processes small and strongly decurved; fronto-nasal region sulcate and strongly dished; rostrum rather short and narrow; nasals horizontal except posteriorly, where they rise strongly; braincase exceedingly long; sagittal crest high posteriorly, straight, and long, reaching anteriorly to halfway between parietals and plane of postorbitals; zygomatic arches moderately spreading, subtriangular (not outbowed), expanded vertically; palate and postpalatal shelf relatively long and narrow for so large a skull; postpalatal notch rather narrow and short; occipito-sphenoid long (about 103 mm.); mastoids outstanding; anterior nares rather small, subtruncate, and broader than high in type skull, higher and less truncate in the Iliamna skulls. Underjaw absent in type specimen, but in an old male from Iliamna on north side of Cook Inlet (No. 209885) which in most respects closely matches the type, the ramus is broadly flattened vertically, much broader posteriorly than anteriorly, and the coronoid blade is high and rather vertical. In younger skulls from Iliamna the coronoid is broader basally and less high. Canines large and massive; molars moderate. The last upper molar is large in the type, smaller and more cut away on outer side of heel in the Iliamna specimens. No. 209885 from Iliamna agrees with the type, except that the nares is higher and less truncate, and the last upper molar smaller, with heel more cut away on outer edge.

Old female (No. 209881, from head of Chitina River, 80 miles from McCarthy, Alaska; collected by Capt. J. P. Hubrick): Size medium; cranium moderately arched; frontal shield broad, deeply sulcate anteriorly, strongly swollen over and posterior to orbits, the point lyrate and reaching parietals; postorbitals rather large, blunt, and somewhat decurved; fronto-nasal region strongly dished and depressed medially; rostrum rather large and high, nearly horizontal; palate and postpalatal shelf broad; postpalatal notch moderate and rather broad. Underjaw long; coronoid blade high and rather narrow, its apex only slightly recurved. Dentition light; canines small and short; molars rather narrow, apparently normal (too badly worn to admit of description, except that the heel of M^2 is moderately long and rather broadly rounded posteriorly).

Cranial comparisons.—Old male (type) compared with old male *dalli:* Size about the same; vault of cranium and frontal shield much more elevated, less flat, less nearly horizontal, and much more swollen over orbits; shield more deeply sulcate; postorbitals weak and decurved (in *dalli* larger and more horizontally outstanding); fronto-nasal region more strongly dished; rostrum narrower and longer; zygomata much less widely outstanding and much less bowed; palate longer; molars very much larger.

Old male (type) compared with adult male *nuchek* (type): Size, elevation of vault of cranium, and zygomatic breadth about the same; frontal shield somewhat broader, much more highly arched, much more swollen over orbits, much more deeply sulcate medially, shorter and more acutely pointed posteriorly; postorbitals smaller and more decurved; fronto-nasal region strongly dished; rostrum more depressed; nares more truncate; last upper molar of normal form, large, and with long posteriorly rounded heel, differing widely from the short, broad-in-the-middle, obliquely truncate tooth of *nuchek.*

Skull measurements.—Old male (type): Basal length, 357; occipito-nasal length, 354; palatal length, 199; zygomatic breadth, 244; interorbital breadth, 97.

URSUS ALEXANDRÆ[1] MERRIAM.[2]

ALEXANDER GRIZZLY.

Ursus alexandræ Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 174–175, August 18, 1914.

Type locality.—Kusilof Lake, Kenai Peninsula, Alaska.

Type specimen.—Skull No. 4752, ♂ old, Museum of Vertebrate Zoology, University of California; original No. 218. Collected September, 1906. (Skull, skin, and skeleton complete.)

Range.—Kenai Peninsula, Alaska.

Characters.—Size very large; skull long and narrow; rostrum exceptionally broad for a grizzly; pelage very uniform in color, scarcely or not grizzled; claws enormous (second foreclaw of type specimen measuring: length from upper base, 91 mm; height at base, 25; breadth, 11.5). The longest claw in a specimen collected by Wilson Potter measures 120 mm.; in a male killed by Dall DeWeese, 110 mm.

Color.—Type, very old male, in fresh short fall pelage: General color pale, almost grayish brown, becoming yellowish brown between ears, contrasting with pale brown of muzzle; legs and feet only slightly darker than back; entire animal remarkably unicolor; underfur plumbeous, crinkled, and wooly. Another male, killed by Wilson Potter, of Philadelphia, in May, 1912 (belonging to skull No. 181102, presented by Wilson Potter), is pale buffy inclining to light reddish brown throughout, without grizzly appearance; legs only slightly darker. One killed by Dall DeWeese, of Canyon City, Colorado, September 7, 1897, is described by him as "grayish-yellow," with legs and sides chocolate-brown.

Cranial characters.—Skull large, long, rather narrow, with moderately spreading zygomata, short flattish frontal shield, outstanding postorbitals (with age); very broad rostrum for a grizzly, and long and high sagittal crest. Frontal shield not markedly elevated above plane of rostrum; posterior root of zygoma not expanded. Canines large and long.

Cranial comparisons.—Adult male compared with adult male *kenaiensis:* Basal length, palate, and occipito-sphenoid length essentially the same; skull as a whole much narrower, frontal shield interorbitally and across postorbital processes much narrower, flatter, more nearly horizontal, not materially elevated above plane of rostrum; zygomata much less widely spreading, squamosal part much narrower (not expanded); sagittal crest much longer, reaching anteriorly over posterior third of frontals (in *kenaiensis* ending on or near frontoparietal suture); posterior third of frontals compressed, rising in a keel to sagittal crest. Canine teeth, both upper and lower, but especially the lower, much larger and longer.

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[1] Named for Annie M. Alexander, founder of the Museum of Vertebrate Zoology, University of California, Berkeley.

[2] Tentatively included in *innuitus* group. (See Introduction, pp. 12–13.)

Remarks.—The skull of *alexandræ* is of a generalized type, lacking the special distinctive features that characterize several of its neighbors—as *kenaiensis*, *sheldoni*, and others—none of which are true grizzlies. Among the grizzlies it stands alone in the great breadth of the rostrum, which in bears of its size is only exceeded by the widely different *kenaiensis*. *Ursus alexandræ* attains the largest size known among the grizzly bears, the biggest skulls equaling those of the huge *magister* of Southern California.

Skull measurements.—Old male (type): Basal length, 355; occipito-nasal length, 358; palatal length, 191; zygomatic breadth, 252; interorbital breadth, 87.

Townsendi Group.

URSUS TOWNSENDI[1] MERRIAM.

TOWNSEND BEAR.

Ursus townsendi Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 151–152, September 6, 1916.

Type locality.—Mainland of Southeastern Alaska (exact locality uncertain).

Type specimen.—No. 216643, ♂ old, U. S. National Museum. Purchased at Sitka, in 1889, by Dr. Charles H. Townsend.

Cranial characters.—Skull large, long, massive, rather low, and flat topped, dished, with extremely small teeth. Shield broad, flat, slightly depressed medially, the point ending anterior to parietals, sides reaching out broadly into very broad postorbitals, strongly sloping to rostrum; rostrum moderate, flat or depressed on top; nares truncate; zygomata moderately outstanding and moderately bowed; squamosal base broadly and abruptly expanded vertically; palate and postpalatal shelf moderate; notch rather narrow; mastoids long; occipito-sphenoid 95 mm.; basisphenoid rather deeply concave. Underjaw long; ramus broad and flat vertically; coronoid of moderate height, narrowing above, sloping strongly backward, apex cutting plane of posterior part of condyle; upper two-thirds of anterior border strongly inflected.

Cranial comparisons.—Old male (type) compared with male *caurinus*: Skull much larger, broader, more massive, and less arched; teeth smaller. Frontal shield very much broader interorbitally and postorbitally (interorbitally 91 mm. contrasted with 81 or less;

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[1] Named for Dr. Charles H. Townsend, formerly naturalist of the Fish Commission steamer *Albatross*, now director of the New York Aquarium, who collected the specimen and presented it to the U. S. National Museum.

across postorbitals 130 contrasted with 116); postorbitals very much broader and flatter; rostrum more nearly horizontal; nares truncate instead of sloping; zygomata more widely outstanding and more broadly expanded vertically.

Skull measurements.—Old male (type): Basal length, 348; occipito-nasal length, 353; palatal length, 183; zygomatic breadth, 245; interorbital breadth, 91.5.

Dalli Group.

URSUS DALLI[1] MERRIAM.

DALL BROWN BEAR.

Ursus dalli Merriam, Proc. Biol. Soc. Washington, X, pp. 71–73, April 13, 1896.

Type locality.—Yakutat Bay (northwest side), Alaska.

Type specimen.—No. 75048, ♂ old, U. S. National Museum.

Range.—Malaspina Glacier and region northwest of Yakutat Bay, Alaska.

Characters.—Size very large; skull without very pronounced characters, although differing sufficiently from its neighbors. General color dark brown, strongly grizzled.

Color.—*Adult male* (from Malaspina Glacier, belonging to skull No. 210293, killed by G. Frederick Norton): Muzzle pale brown, becoming much darker on head and sides of face; general body color dark brown, moderately grizzled with pale-tipped hairs, the grizzling beginning on top of head a little in front of plane of ears and extending posteriorly to middle part of back.

Cranial characters.—*Adult male:* Skull large, vault of cranium fairly high but not arched; frontal shield broad, rather flat, broadly sulcate or concave medially, rather short pointed posteriorly, with large, rounded, broadly outstanding postorbital processes; frontonasal region moderately dished; rostrum broad and short, in some skulls slightly depressed; sagittal crest of medium length, rather high and nearly straight; zygomata rather broadly outstanding and strongly outbowed; squamosal root expanded in old age; squamosal shelf broad; braincase narrow anteriorly, tending to keel into sagittal crest; nares small.

Note.—The type skull of *dalli* (No. 75048, ♂ old) is abnormal: abnormally large, abnormally high (vault of cranium abnormally arched); fronto-nasal region abnormally elevated—not dished as usual; and underjaw abnormally long. No. 75047 (old ♂) and No. 210293 (adult ♂) are far more typical.

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[1] Named for William H. Dall, of the Smithsonian Institution.

Adult females (No. 140085, from Copper River delta, July, 1905, A. G. Maddren; and old female, No. 210308, from Bering Lake, 1915, J. L. Hill): Size, medium; skull broad and short for a female; moderately arched, and moderately dished, with rather broad frontal shield and broad rostrum. Frontal shield rather broad, strongly sulcate medially, swollen over orbits; postorbital processes rather weak and strongly decurved; point of shield ending at fronto-parietal suture; fronto-nasal region strongly sloping, rostrum large, broad, and rather short; sagittal crest confined to parietals, high for a female; postpalatal shelf medium or broad, strongly rounded on sides; zygomata moderately spreading, subtriangular, the posterior base somewhat bowed and vertically expanded; underjaw rather short; coronoid high, falcate, the apex cutting or overreaching plane of condyle; teeth medium; heel of M^2 rather long, slightly emarginate on outer side, the extreme tip with tendency to turn outward.

Cranial comparisons.—Adult and old males (Nos. 75047 and 210293) compared with adult male *nuchek* (No. 146459, type): Size about the same (basal length essentially same, but occipito-nasal length decidedly less); frontal shield broader and more acutely pointed; vault of cranium less high and more nearly horizontal; postorbitals more outstanding; rostrum slightly shorter and more depressed (appearing broader); zygomata more outbowed (less triangular); palate somewhat shorter; mastoids more appressed, closer to glenoid processes, constricting meatus tube (in *nuchek* more outstanding, leaving wide postglenoid space with correspondingly large open meatus); coronoid blade broader above (less falcate). Canines almost the same; molars decidedly smaller and less massive and in details quite different (as stated under *nuchek*).

Adult female (No. 140085, from Copper River delta) compared with female *nuchek* (No. 44049, from near Mount St. Elias): Skulls so different as not to require close comparison, that of *dalli* being massive, broadly arched or domed, and with massive underjaw, while that of *nuchek* is light, slender, and narrow, with low narrow flattened frontal region, long slender rostrum, and light underjaw. The teeth also differ strikingly.

Adult and old male compared with old male *cressonus* (type): Size about the same; vault of cranium and frontal shield much less elevated, flatter, more nearly horizontal, and much less swollen over orbits; shield less deeply sulcate; postorbitals larger and more horizontally outstanding (in *cressonus* weak and decurved); fronto-nasal region less strongly dished; rostrum broader and shorter; zygomata much more widely outstanding and much more bowed; palate shorter; molars very much smaller.

Adult and old female compared with old female *cressonus:* Skull larger, broader, and more highly arched; frontal shield broader, less deeply sulcate and less swollen over orbits; fronto-nasal region more strongly dished; rostrum smaller and lower; zygomata less outstanding, less arched, much less expanded vertically and more sharply angular; underjaw much shorter and lighter; coronoid smaller and lower. Teeth smaller throughout.

Adult and old male compared with adult and old male *kenaiensis:* Size the same or somewhat smaller; skull much less massive; braincase conspicuously narrower; frontal shield interorbitally narrower, shorter pointed posteriorly; fronto-nasal region normally more strongly dished; postorbital processes less broadly rounded; rostrum less massive and less elevated; sagittal crest much longer; occipito-sphenoid shorter; mastoids usually less outstanding.

Skull measurements.—Old male (No. 75047, from Yakutat Bay, Alaska): Basal length, 345;[1] occipito-nasal length, 342; palatal length, 190; zygomatic breadth, 263; interorbital breadth, 91.5. Old male (No. 210293, from Malaspina Glacier): Basal length, 345; occipito-nasal length, 338; palatal length, 188; zygomatic breadth, 248; interorbital breadth, 96.

URSUS HOOTS[2] MERRIAM.

STIKINE BROWN BEAR.

Ursus hoots Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 140–141, September 6, 1916.

Type locality.—Clearwater Creek, a north branch of Stikine River, British Columbia.

Type specimen.—No. 206136, ♂ ad., U. S. National Museum, Biological Survey collection. Collected by John Hyland; presented by Lincoln Ellsworth.

Cranial characters.—Size medium or large; skull massive; slightly dished, rather short, flattish on top, very broad across frontals and rostrum. Frontal shield broad, nearly flat, long pointed; broadly and shallowly sulcate medially as far back as posterior plane of postorbitals; postorbitals large, broad, and horizontally outstanding; fronto-nasal region sloping; rostrum broad and rather high; palate and postpalatal shelf broad; postpalatal notch moderate; sagittal crest short, ending at fronto-parietal suture; zygomata moderately outbowed, not broadly spreading; underjaw rather massive; ramus broad vertically, its inferior border upcurved posteriorly; coronoid blade broad at base, rather high and subfalcate, the apex curving strongly backward, cutting plane of condyle; dentition remarkably light for so large a skull; canines and molars (both upper and lower) surprisingly small.

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[1] Restored.

[2] *Hoots,* the native Indian name for the big brown and grizzly bears of the coast region.

Remarks.—*Ursus hoots* does not appear to be related to any of the other mainland species except the newly discovered *crassus* from the mountains on the upper Macmillan River, Yukon, from which it may be distinguished at a glance by the small size of its molar teeth. It may be related also to *sitkensis* of Baranof and Chichagof Islands, but differs in somewhat smaller size; less elevated posterior frontal region; broader postorbital processes; less broadly spreading zygomata; shorter and less spreading mastoids; less nearly vertical and more strongly recurved coronoid blade, the apex overarching a well-defined coronoid notch; smaller molars (both upper and lower); and smaller upper incisors. The large lower premolar has the upturned heel of the Sitka bear, but lacks the posterior sulcus and pair of cusplets of the grizzlies. Two additional old male skulls of *hoots* have been recently received from the Stikine River region. One of these (No. 224841) from Clearwater branch of Stikine—the type locality—agrees closely with the type specimen in size and form, but has slightly larger and especially broader molars (difference most marked in M). The skull is older than that of the type and the mastoids are more strongly developed and divergent. The other (No. 224839) is still older and was killed low down the Stikine. It is of approximately the same size as the type, but considerably older; the frontal shield is more broadly concave interorbitally and shorter pointed posteriorly; sagittal crest more strongly developed; squamosal base of zygoma much more broadly expanded; mastoids much longer and strongly divergent; postpalatal shelf flatter; coronoid blade broader at and above middle; molars slightly larger. An adult female from the type locality (No. 180883, from Clearwater branch of Stikine) resembles the male type very closely except for the smaller size of skull and teeth, and therefore needs no special description. A feature deserving mention is that in both sexes the point of the frontal shield ends at the fronto-parietal suture.

Skull measurements.—Adult male (type): Basal length, 333; occipito-nasal length, 325; palatal length, 179; zygomatic breadth, 228; interorbital breadth, 96.

URSUS SITKENSIS Merriam.

Sitka Brown Bear.

Ursus sitkensis Merriam, Proc. Biol. Soc. Washington, X, p. 73, April 13, 1896.

Type locality.—Sitka Islands, Alaska.

Type specimen.—No. 187891, ♂ ad., U. S. National Museum (No. 6543, Merriam collection). Collected by an Indian; purchased at Sitka, Alaska, and presented to C. Hart Merriam by J. Stanley-Brown.

Range.—Sitka Islands (Baranof and Chichagof), Alaska.

Characters.—Size large; coloration very dark; claws of moderate length, curved, dark blue-black, scurfy; skull broad and massive.

Color.—Dark; muzzle dark brown, sometimes chocolate brown or even sooty, paler in faded summer pelage; head and body very dark brown or even dusky, varying to dull brown in summer, washed on back of head, neck, and shoulders with yellowish or golden.

Cranial characters.—*Adult male:* Skull large, massive, dished, vault moderately elevated, frontal shield (normally) broad, strongly sloping, sulcate medially; postorbitals outstanding, broadly rounded; rostrum normally rather short and somewhat depressed; sagittal crest massive, straight; zygomata broadly outstanding and outbowed; palate moderate; postpalatal shelf normally rather long and of medium breadth; notch moderate or rather narrow; basioccipital broad; mastoids long and spreading.

Cranial comparisons.—Adult and old males compared with adult and old male *dalli:* Frontal shield higher posteriorly (in *dalli* highest at or immediately behind postorbitals), flatter and more sloping at base of postorbitals, thus tilting postorbital plane forward (in *dalli* looking more directly upward); a distinct thickening or hump present on each side of median sulcus behind plane of postorbitals (lacking in *dalli*); basioccipital usually broader; inion less strongly developed; mastoids longer, usually more outspreading and more distant from glenoid processes, leaving broader space for audital canal; auditory meatus larger; rostrum somewhat broader basally; distance from last lower molar to middle of condyle usually less; last upper molar somewhat longer and more nearly rectangular, the outer side of heel less oblique; $M_{\overline{1}}$ normally with open saddle between posterior and anterior parts (in *dalli* a cusplet occupies the inner side of the saddle); $PM_{\overline{4}}$ in *sitkensis* normally tricuspidate as seen in profile, there being both anterior and posterior cusplets on the cingulum (in *dalli* the anterior and posterior cusplets are absent and the main cusp is larger and higher and slopes posteriorly without horizontal heel).

Skull measurements.—Average of 2 adult males from Chichagof Island: Basal length, 358.5; occipito-nasal length, 354.5; palatal length, 189; zygomatic breadth, 260; interorbital breadth, 93.5.

URSUS SHIRASI[1] MERRIAM.

SHIRAS BROWN BEAR.

(Pl. VI.)

Ursus shirasi Merriam, Proc. Biol. Soc. Washington, XXVII, p. 195, August 18, 1914.

Type locality.—Pybus Bay, Admiralty Island, Alaska.

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[1] Named for George Shiras, 4th, who collected and presented the specimen.

Type specimen.—No. 203030, ♂ old, U. S. National Museum, Biological Survey collection. Killed September 16, 1913, by George Shiras, 4th, and presented to the Biological Survey.

Range.—Restricted to Admiralty Island.

Characters.—A huge brown bear larger than the largest *sitkensis;* head highly arched; color black, except muzzle, which is dull brown; claws dark blue-black, dull, slightly scurfy (not smoothly polished as in the grizzlies), rather strongly curved and of moderate length (middle claw over curve, 92 mm.; from top of base to apex, 75), fourth and fifth rounded off on outer side.

Color.—Entire animal, except muzzle, coal black, showing when examined closely a brownish wash along middle of back; muzzle from nose pad to between eyes dull brown.

Cranial characters.—Old male (type): Skull large, broad, massive, strongly dished, and highly arched; zygomata large, broadly outbowed and rounded anteriorly as well as posteriorly; frontal shield remarkably short and broad (nearly twice as broad as long), deeply and broadly concave in cross section, with huge uplifted[1] broadly outstanding postorbital processes which arch over the orbits and are strongly decurved apically, completely roofing the orbits; temporal ridges beaded, short, meeting far forward (at least 25 mm. in front of fronto-parietal suture); sagittal crest long and high, humped over fronto-parietal suture; fronto-nasal region strongly concave; rostrum broad and short, rising strongly to meet frontal shield; palate broad; basioccipital and basisphenoid subequal; ramus strongly bellied under posterior molars; coronoid blade broad and high.

Dental characters.—Dentition heavy; canines large, the upper 47 mm. high above enamel line of outer side; molars large and rather broad; M^2 with large and broad heel; $\text{M}_{\overline{1}}$ with strongly developed cusplet on inner side of saddle.

Remarks.—*Ursus shirasi* is a very large member of the brown bear group. Whether it is always black, like the type specimen, is not known. But of all the American bears its skull is the most striking and distinctive. The short broad frontal shield rising on each side into huge postorbital processes, which arch broadly over the orbits, serve to distinguish it at a glance from all other species, rendering close comparisons unnecessary. In this connection it is interesting to observe that *shirasi* and its neighbor *eulophus*, an inhabitant of the same island, present opposite extremes of departure from the normal ursine type—*eulophus* having a long narrow skull with slender elongate rostrum, long and narrow frontal shield, and insignificant postorbital processes, while *shirasi* has an exceptionally broad skull with broad short rostrum, excessively broad and short frontal shield, and huge massive postorbital processes.

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[1] Additional skulls of adult males recently received have the postorbitals equally large but less uplifted, not rising above frontal plane.

Skull measurements.—Adult male (type): Basal length, 355; occipito-nasal length, 348; palatal length, 191; zygomatic breadth, 259; interorbital breadth, 104.5.

URSUS NUCHEK MERRIAM.[1]

NUCHEK BROWN BEAR.

Ursus nuchek Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 146–148, September 6, 1916.

Type locality.—Head of Nuchek Bay, Hinchinbrook Island, Prince William Sound, Alaska.

Type specimen.—No. 146459, ♂ old, U. S. National Museum, Biological Survey collection. Collected September 15, 1905, by C. Swanson.

Range.—Prince William Sound easterly to Mount St. Elias; limits unknown.

Characters.—Size large; external characters unknown; skull long, narrow, and moderately high; molars peculiar.

Cranial characters.—*Adult male* (type): Large, elongate; frontal shield relatively narrow, flattish, moderately depressed between orbits; orbital rims thickened; postorbital processes broad and flattish, moderately outstanding; posterior part of shield broad, ending about two-thirds distance from plane of postorbitals to fronto-parietal suture; sagittal crest rather long, straight, high posteriorly; rostrum long, high, rather narrow; fronto-nasal region sloping in facial plane; nasals slightly elevated anteriorly; zygomata moderately spreading, subtriangular, not much expanded vertically; postpalatal shelf moderate, its sides rounded; notch long and narrow; anterior nares small; meatus tube short and large. Underjaw massive; coronoid blade narrow and falcate. Teeth of medium size; molars broad (more massive than in *dalli*); last upper molar exceptionally short, broadest in middle, heel short and obliquely truncate on outer side; M^1 large, much broader posteriorly than anteriorly; middle lower molar peculiar: twin cusps of entoconid very small, low, and close together; main cusp of inner side large and high, reducing the posterior moiety of the tooth to about a third the length of the crown instead of about half as usual.

Young-adult female (No. 44049, from Chaix Hills near Mount St. Elias, Alaska; killed July 4, 1891, by the late Prof. I. C. Russell): Skull long, narrow, rather low, with narrow frontals, narrow rostrum, and moderately outstanding subtriangular zygomata. Frontal shield flattish, medially depressed interorbitally, sloping gradually into rostrum, rather short pointed posteriorly (ending about 15 mm. in front of parietals; in fully adult and old females it would be still shorter); postorbital processes moderate, horizontally outstanding, the tips rounded (not fully grown); palate concave, postpalatal shelf rather long and broad; notch rather narrow; basisphenoid strongly concave antero-posteriorly and transversely; underjaw long and slender. Canines long and slender; molars and large premolars with rather high cusps; last upper molar short, much broader in middle than anteriorly, heel short and obliquely truncate on outer side.

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[1] Tentatively included in *dalli* group. (See Introduction, pp. 12–18.)

Cranial comparisons.—*Ursus nuchek* evidently overlaps the range of *dalli* and may come in contact with *cressonus*, necessitating comparisons with both.

Adult male (type) compared with adult and old male *dalli* (Nos. 75047 and 210293): Size about the same; basal length essentially the same, but occipito-nasal length decidedly greater; skull appearing longer and narrower; more elevated behind orbits and much more strongly sloping posteriorly; frontal shield narrower, the point broader posteriorly; vault of cranium higher and less nearly horizontal; postorbitals less outstanding; fronto-nasal region less dished; rostrum longer and not depressed (appearing narrower); zygomata less outbowed (more triangular); palate somewhat longer; postpalatal notch longer and narrower; mastoids less appressed, leaving wide postglenoid space with correspondingly large open meatus (in *dalli* closer to glenoid process, pressing on and contracting meatus tubes); coronoid blade narrower above (more falcate). Canines about the same; molars, both upper and lower, decidedly larger and more massive and in details quite different: M^2 exceptionally short and much broader in middle than elsewhere, the heel short and obliquely truncate on outer side; M^1 large, much broader posteriorly than anteriorly; middle lower molar peculiar, the twin cusps of entoconid very small, low, and close together; metaconid exceptionally large and high, reducing the posterior moiety of the crown to about one-third its length, instead of about half as in *dalli* and most species.

Young-adult female (No. 44049, from near Mount St. Elias) compared with adult female *dalli* (No. 140085, from Copper River delta): Skulls so strikingly different as not to require close comparison, that of *nuchek* being light, slender, narrow, with low narrow flattened frontal region, long slender rostrum, and light underjaw, while that of female *dalli* is massive, broadly arched or domed, and with massive underjaw. The teeth also differ strikingly.

Young-adult female (No. 44049) contrasted with old female *cressonus* (No. 209881): Size slightly smaller (when fully adult probably the same); frontal shield much narrower and flatter, much less deeply sulcate, much less swollen over orbits, and much shorter posteriorly; fronto-nasal region in same plane (in ♀ *cressonus* strongly dished); sagittal crest longer; nares smaller; canines (upper and lower) much longer; molars more massive; M^2 extremely short, much the broadest in middle, with short obliquely truncate heel (in *cressonus* normal).

Female (No. 44049) compared with female *kenaiensis* (No. 133244): Basal length essentially the same; cranium narrower, with narrower braincase, narrower shield, and narrower rostrum; zygomata less broadly spreading (would be more broadly spreading with age); occipito-sphenoid shorter; palate essentially same length but narrower; postpalatal shelf narrower; ramus more slender (conspicuously thinner below $\mathrm{M}_{\overline{2}}$ and $\mathrm{M}_{\overline{3}}$); its inferior border straighter, less upcurved posteriorly; coronoid lower and less narrowed above; cusps of larger premolars above and below much more highly developed; main cusp of upper premolars very much higher relative to posterior cusp; molar cusps also more strongly developed; last upper molar shorter and of peculiar form, as in the male.

Skull measurements.—Old male (type): Basal length, 360;[1] occipito-nasal length, 358; palatal length, 191; zygomatic breadth, 248; interorbital breadth, 88.

Gyas Group.

URSUS GYAS MERRIAM.

PENINSULA GIANT BEAR.

(Pl. II.)

Ursus dalli gyas Merriam, Proc. Biol. Soc. Washington, XV, p. 78, March 22, 1902.

Ursus merriami Allen, Bull. Amer. Mus. Nat. Hist., XVI, p. 141, April 12, 1902.

Type locality.—Pavlof Bay, Alaska Peninsula.

Type specimen.—No. 91669, ♂ ad., U. S. National Museum, Biological Survey collection.

Range.—Entire length of Alaska Peninsula from Cook Inlet to Isanotski Strait and adjacent Unimak Island.

Characters.—Size huge, either largest living bear or second only to the great Kadiak bear (*middendorffi*). Claws rather long and smooth, dark when young, pale when old. Color variable, from grizzled brown to pale yellowish. Skull of male large, long, and massive, but not highly arched. Sexual disparity great.

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[1] Restored.

Cranial characters.—Adult males: Skull large, long, and massive; frontal region moderately elevated, sloping gradually into rostrum, strongly depressed or troughed medially; slightly swollen over orbits and bases of postorbitals; postorbitals rather large, subtriangular, moderately outstanding; zygomata moderately outstanding and bowed; palate long and relatively narrow. Underjaw long and massive; coronoid blade very broad basally. Molars light for so large a skull. Viewed from behind, the posterior frontal region, with its depressed median trough and massive, outstanding, and elevated postorbital processes, suggests the spread wings of a bat or a butterfly.

Skulls of adult males which it seems necessary to call *gyas* present a surprisingly wide range in size and form. Among them are three quite different types which if isolated would undoubtedly develop into very distinct species.

1. *Typical form, with large elongate skull.*—Skull and teeth large and massive; zygomata widely spreading; sagittal crest high; frontals moderately elevated, broadly sulcate medially, swollen laterally; postorbital processes thick, massive, subtriangular, and decurved; nasal opening and rostrum proportionate to size of skull (but anterior nares very much smaller than in *middendorffi*). Teeth large; lower canines averaging about 19 mm. in diameter at base of enamel. This large form ranges over the entire length of Alaska Peninsula from Cook Inlet (where it was obtained at Chinitna by Kidder and Blake) to Morzhovoi Bay and Unimak Island. *Departures from normal:* The series of skulls at hand shows two prominent departures from typical *gyas*—one larger and more massive, the other smaller and lighter.

2. *Giant form, with exceptionally broad rostrum.*—Huge skulls with *broad massive rostrum* and exceedingly heavy jaws. This type is represented in the Biological Survey collection by two specimens, No. 91694 from Cold Bay, and No. 91704 from Belkofski Bay. The entire skull is larger and more massive, but the differences are most pronounced in the face and jaws. The frontal shield and postorbital processes are not broader than in some skulls of typical *gyas*, but the postorbital processes are *abruptly deflexed* at the tips, forming a thick massive hook over the orbit, much as in *middendorffi*. The rostrum is extraordinarily broad and massive, giving the skull, viewed from the front, a most peculiar aspect. The occipital flange (lambdoid crest) also is largely developed. The peculiarities of the underjaw are as striking as those of the rostrum. The inferior part of the ramus is greatly thickened anteriorly, and the posterior half is *strongly everted*, forming a broad lip, unlike anything seen in typical *gyas*. By reason of this peculiarity the jaws flare strongly outward under the last molars, and the flaring is so great that it is conspicuous even when looked at from above.

3. *Small form, with narrow rostrum.*—Smaller skulls, with narrower rostrum, more slender, horizontally outstanding postorbital processes and much smaller canines (exemplified by Nos. 82003 and 82004 from Pavlof Bay, and No. 91699 from Belkofski Bay). Compared with typical *gyas*, the skull as a whole is considerably smaller, shorter, and lighter; vault of cranium rather more flattened; rostrum decidedly narrower; canine teeth above and below decidedly more slender; last upper molar narrower. But the most conspicuous difference is in the postorbital processes, which instead of being broadly tri-

angular, massive, and decurved, are elongate, peglike, and stand out horizontally.

The above description applies to fully adult males of the form described by Allen under the name *Ursus merriami*, the type of which was an immature male. Unfortunately for *merriami*, the typical form seems to be connected with *gyas* by a series of intergrades. Thus, skull No. 862, Field Mus. Nat. Hist., has the small teeth and narrow muzzle of *merriami*, but the postorbital processes are broader posteriorly and slightly decurved; and Nos. 91691, 147630, 91675, U. S. Nat. Mus., Biological Survey collection, and No. 4585, Mus. Vert. Zool., Univ. California, complete the chain of intergrades, so that it is difficult to tell just where to draw a line between them.

Skulls of adult males of the small form have been examined from various localities from Cold Bay and Ugashik Lake and River westerly to Pavlof, Belkofski, Bear Bay, and Tonki Point.

Adult females: Skull of moderate size, conspicuously smaller than male; frontal region normally *elevated, domed, and rounded off*, the postorbital processes somewhat decurved, the frontal shield sulcate medially. Skulls of adult females differ among themselves in degree of elevation and doming of frontal shield, depth of median groove, relative massiveness, and other characters, but in the present imperfect state of knowledge it is impossible to assign positively any particular female to either of the above-described types of males.

Cranial comparisons.—Old male compared with old male *middendorffi* of essentially same size: Vault of cranium much less highly arched and never domed; postorbital processes more strongly developed and less decurved; zygomata less widely outstanding and far less bowed (ratio of zygomatic breadth to basal length much less); anterior nares normal, not flaring; coronoid blade less high. Last upper molar shorter and of different form, the heel obliquely truncate on outer side, narrowing posteriorly; lower molars broader and heavier.

Skull measurements.—Old male (type): Basal length, 380; occipito-nasal length, 394; palatal length, 206; zygomatic breadth, 286; interorbital breadth, 96.

URSUS MIDDENDORFFI MERRIAM.

KADIAK BEAR.

(Pl. III.)

Ursus middendorffi Merriam, Proc. Biol. Soc. Washington, X, pp. 67–69, April 13, 1896.

Ursus kadiaki Kleinschmidt, Outdoor Life, XXVII, p. 3, January, 1911.

Type locality.—Kodiak Island, Alaska.

Type specimen.—No. 54793, ♂ young-adult, U. S. National Museum, Biological Survey collection. Collected July 3, 1893, by B. J. Bretherton (original No. 176).

Range.—Kodiak and adjacent islands, Afognak and Shuyak; not known from mainland.

Cranial characters.—Size huge; skull of male exceedingly broad, high, and relatively short; frontal shield domed, sulcate medially and swollen over orbits (obliquely flattened in extreme age), rather short pointed posteriorly, passing into sagittal crest in fully adult skulls anterior to fronto-parietal suture; fronto-nasal region dished; postorbitals decurved and weak, small for size of skull; rostrum rather short and of medium breadth; anterior nares flaring; zygomata *extraordinarily outstanding and strongly outbowed;* palate rather broad; postpalatal shelf rather narrow; mastoids long and divergent. Underjaw large, massive, and rather short; coronoid blade high and moderately recurved; molars small for size of skull.

Cranial comparisons.—Old male compared with old male *gyas* of essentially same size: Vault of cranium much more highly arched and usually domed; postorbital processes weak and decurved; zygomatic arches much more widely outstanding and far more strongly bowed (ratio of zygomatic breadth to basal length much greater); anterior nares strongly flaring (in *gyas* not flaring); coronoid blade higher. Last upper molar with heel more broadly rounded; lower molars narrower.

Flesh measurements.—Young-adult male killed by J. H. Kidder on Shuyak Island, off Afognak, Alaska, July, 1901: Total length, nose to end of tail vertebræ, 8 ft.; nose to base of tail, 7 ft. 8¾ in.; height at shoulders, 4 ft. 5½ in.; length of forefoot, including claws, 1 ft. 2¼ in.; hind foot, 1 ft. 4 in.; width of forefoot, 8¼ in.; width of hind foot, 7⅝ in.; length of fore claws, 4¼ in.; girth of body behind shoulders, 5 ft. 1⅝ in.; girth of neck, 3 ft. 2 in.; girth of head at ears, 3 ft. 1¾ in.; nose to tip of hind foot (animal lying on one side), 9 ft. 11 in. The body after the skin was removed was the size of a big ox.

Skull measurements.—No. 134407, largest of the males: Basal length, 392; occipito-nasal length, 369; palatal length, 211; zygomatic breadth, 306; interorbital breadth, 101.

Kenaiensis Group.

URSUS KENAIENSIS Merriam.

Kenai Giant Bear.

(Pl. IV.)

Ursus kenaiensis Merriam, Proc. Biol. Soc. Washington, XVII, p. 154, October 6, 1904.

Type locality.—Cape Elizabeth, at extreme west end of Kenai Peninsula, Alaska.

Type specimen.—No. 128672, ♀ ad., U. S. National Museum, Biological Survey collection. Collected in 1903 by C. A. Lambert.

Range.—Kenai Peninsula.

Characters.—Size large; appearance that of a big grizzly; coloration rather dark; claws moderately curved, dark, usually marked with whitish streaks on sides and near tip; longest claw in three adults 82–90 mm. Skull broad and massive, that of male strikingly larger than female.

Color.—Old male killed in October, 1912, by Wilson Potter, of Philadelphia (skull 181099): Muzzle pale fulvous-brown; cheeks and forehead similar but hairs longer and with pale tips; ground color of top of head, neck, and back much darker but deeply washed on tips with buffy or buffy whitish, giving these parts the look of a grizzly; legs and feet (but not belly) much darker.

Cranial characters.—*Adult male:* Skull large, broad, and massive, with broad frontal shield and rostrum, widely outbowed zygomata, large outstanding bluntly rounded postorbitals, and small anterior nares. Frontals broad throughout (interorbitally, postorbitally, and across postorbital processes); frontal shield well elevated above plane of rostrum, shallowly sulcate medially between orbits, slightly swollen over orbits, long pointed posteriorly; sagittal crest short, not reaching anteriorly beyond fronto-parietal suture; braincase broad anteriorly; rostrum broad throughout but much broader posteriorly than anteriorly; zygomata abruptly and widely outbowed, the squamosal root vertically expanded; palate very broad; underjaw large and massive, coronoid blade large and high, scarcely recurved. Canines small and short. *Adult female:* Skull broad, flat, and massive, with exceedingly broad rostrum, broadening posteriorly; zygomata broadly spreading; jugal broad anteriorly; frontals flattened, depressed, low posteriorly; postorbital processes large, blunt, and horizontally outstanding; palate exceedingly broad; nasals large and broad; anterior nares small. Canines small.

Cranial comparisons.—Adult male compared with adult male *alexandræ:* Length essentially the same, but *kenaiensis* much broader and more massive throughout; frontal shield broader throughout (interorbitally, postorbitally, and across postorbital processes), more elevated, convex (not flat) antero-posteriorly, shallowly sulcate interorbitally, slightly swollen over orbits; longer pointed posteriorly, with correspondingly shorter sagittal crest ending anteriorly at fronto-parietal suture; postorbital processes more massive and outstanding; frontal part of braincase not keeled or compressed; rostrum much broader, especially posteriorly; nasals shorter anteriorly; zygomata much more widely and abruptly spreading posteriorly, outbowed instead of angular; squamosal part rising abruptly and broadly expanded vertically, differing strikingly from the more slender and gently curving form in *alexandræ;* palate broader; mastoids more outstanding; ramus longer and more massive; coronoid blade more nearly vertical, higher, broader in upper third, less recurved, not ending in posterior point. Canines, both upper and lower, smaller and shorter.

Adult female compared with adult female *alexandræ:* Skull shorter, both basally and on top; vault of cranium and rostrum lower; fronto-nasal region more dished; rostrum very much broader basally, its sides sloping anteriorly; braincase shorter (less occipital overhang); sagittal crest lower; occipito-sphenoid and base of skull shorter; palate broader; ramus more massive. Canines smaller (the lower notably more slender).

Adult and old males compared with adult and old male *dalli:* Size the same or somewhat larger; skull much more massive; braincase conspicuously broader; frontal shield interorbitally broader, longer pointed posteriorly; fronto-nasal region normally less strongly dished; postorbital processes more broadly rounded; rostrum more massive and more elevated; sagittal crest much shorter; occipito-sphenoid longer; mastoids usually more outstanding.

Skull measurements.—Average of 2 old males from Kenai Peninsula: Basal length, 367; occipito-nasal length, 360; palatal length, 197; zygomatic breadth, 263.5; interorbital breadth, 205. Adult female (type): Basal length, 288.5; occipito-nasal length, 285; palatal length, 158; zygomatic breadth, 214; interorbital breadth, 78.

URSUS SHELDONI[1] MERRIAM.

MONTAGUE ISLAND BEAR.

(Pl. V.)

Ursus sheldoni Merriam, Proc. Biol. Soc. Washington, XXIII, pp. 127–130, September 2, 1910.

Type locality.—Montague Island, Prince William Sound, Alaska.

Type specimen.—No. 137318, ♂ young-adult, U. S. National Museum, Biological Survey collection. Collected May, 1905, by Charles Sheldon.

Characters.—Size large; teeth and claws of the grizzly type; color variable, from dark to light brown. Skull broad and massive; vault of cranium domed; hairs over shoulders elongated to form a small but distinct hump.

Color.—General color brownish, varying from pale to dark, the hairs of the back sometimes yellowish tipped, those of the head grizzled; color darkest (almost blackish) on belly, legs, and feet; ears dark with whitish tips. An old she-bear killed by Sheldon, May 18,

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[1] Named for Charles Sheldon, of New York, who collected and presented the type and other specimens.

1905, is very pale grizzled gray on the upperparts, and only moderately darker on the legs and feet. The cub of this bear, killed the same day, was in its second year (about 16 months old) and is very pale—almost buffy gray—with dark feet and legs, and a strongly marked hump.

Cranial characters.—Adult male (type): Large, massive, exceptionally broad, with broadly outbowed zygomata. Frontal shield long and broad, nearly horizontal from postorbitals posteriorly (actually sloping downward posteriorly); broadly sulcate medially between postorbital processes, moderately swollen on each side, the posterior part long and broad (temporal ridges in type specimen not curving inward as in most skulls), the point falling over middle of parietals (in old age doubtless more anterior); sagittal crest exceptionally short, confined in type skull to posterior half of parietals; fronto-nasal region elevated, forming a convexity instead of the usual depression between plane of rostrum and that of frontal shield; rostrum broad and short; nasals strongly sloping, dished at junction of anterior and middle thirds, the anterior third horizontal or slightly upturned; palate and postpalatal shelf very broad; notch rather broad; zygomata broadly outstanding, rounded posteriorly, somewhat bowed, not much expanded vertically (doubtless more broadly expanded in old age); squamosal shelves exceptionally broad; braincase narrowest on anterior part of parietals instead of on frontals. Underjaw large and massive; ramus broad vertically, broadest under posterior molars; coronoid blade elevated, moderate, vertical, the apex only slightly recurved. Dentition light; canines and molars small for size of skull.

Old female (No. 137316, mother of cub No. 137315) from Montague Island, May 18, 1905, collected and presented by Charles Sheldon: Skull of medium size, broad, flattish on top. Frontal shield flat, nearly horizontal, the posterior part broad and long, reaching past middle of parietals; postorbital processes strongly developed, almost peglike, horizontally outstanding; fronto-nasal region elevated in fronto-facial plane; rostrum short, rather broad; palate and postpalatal shelf broad; zygomata broadly outstanding, subtriangular, rounded posteriorly. Underjaw rather massive; coronoid moderate, the apex only slightly recurved; teeth small for size of skull; braincase very broad.

Cranial comparisons.—Skull in general similar to that of *kenaiensis* but basisphenoid broader and flatter, its length nearly equal to that of basioccipital; posterior roots of interpterygoid fossa more widely spreading; condyle of jaw more exserted (in *kenaiensis* sessile), reaching so far back that a line dropped from peak of coronoid to tip of angle touches or traverses it (in *kenaiensis* this line passes freely behind the condyle); coronoid, in females of same age, smaller and lower, its area for muscular attachment less; ramus of jaw strongly bellied posteriorly, its inferior border below the coronoid strongly convex downward and curving evenly, with only a very slight break, to angular process. (In *kenaiensis* the inferior border of ramus is nearly straight, not appreciably bellied under coronoid, and ends abruptly in a step or jog at some distance behind the angle.)

In general form and appearance skulls of females closely resemble those of female *kenaiensis*, differing chiefly in the characters above mentioned and in certain dental peculiarities, notably the smaller size and more pointed heel of the last upper molar, and the oblique truncation of M^1.

Dental characters.—Teeth in general of the grizzly type. Last (fourth) lower premolar normally with horizontal heel, slightly upturned at posterior end, the shallow median sulcus reaching from cusp to end of heel, its defining ridges ending in slightly developed posterior cusplets. (In *kenaiensis* the last lower premolar is more conical, the heel sloping, the sulcus incomplete, with only a single posterior cusplet—on inner side of main cusp posteriorly.) First upper molar peculiar, having both ends obliquely truncate and parallel, sloping strongly from outer angles backward and inward; inner row of cusps pushed back so that each falls behind plane of corresponding cusp on outer side; tooth as a whole more nearly rectangular, its inner corners more nearly square (less rounded), and inner side more flattened and much less convex than in *kenaiensis*.

In the females the last lower molar is conspicuously smaller than in *kenaiensis*, and the last upper molar is smaller, narrower, more wedge-shape, and more pointed posteriorly. In one of the males it is similar. In the other three males the last upper molar is larger and less acute posteriorly than in the females, and the third cusp on the inner side is better developed.

Skull measurements.—Adult male (type): Basal length, 269; occipito-nasal length, 315; palatal length, 198; zygomatic breadth, 270; interorbital breadth, 102.5.

VETULARCTOS, A NEW GENUS RELATED TO URSUS.

Generic characters.—Skull like that of *Ursus*.[1] Teeth in the main like those of *Ursus*, but $M_{\overline{2}}$ quite different, presenting a broad flat squarish grinding surface with suppression of the hypoconid and entoconid, and absence of the usual posterior cusp and notch on outer side. M^2 with outer cusps (paracone and metacone) normal; inner cusps (protocone and hypocone) obsolete. $M_{\overline{2}}$ with anterior part (protoconid and metaconid) normal but rather low; posterior part occupying more than half of crown, a flat rectangular platform, truncate posteriorly, and bordered by a low marginal rim bearing a single small cusp on inner side immediately behind the metaconid; hypoconid absent; entoconid obsolete; outer side of tooth nearly flat, without sulcus or reentrant angle and without notch between protoconid and hypoconid.

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[1] The type is a young-adult female. Skulls of adult males may show cranial differences.

In the reduction or suppression of the inner cusps of M^1 and M^2, and of both inner and outer cusps of the large posterior moiety of $M_{\bar{2}}$, together with the absence of a reentrant angle and notch on the outer side of $M_{\bar{2}}$, *Vetularctos* resembles *Arctotherium* and *Tremarctos*. The details of these and other teeth in the three genera, however, are quite different and the genera have little in common. Nevertheless the resemblances are sufficient to suggest that *Vetularctos* may claim a rather ancient line of descent, from which *Arctotherium* and *Tremarctos* also arose—a line quite different from the one culminating in *Ursus* proper.

Type species.—*Vetularctos inopinatus.*

VETULARCTOS INOPINATUS sp. nov.

Patriarchal Bear.

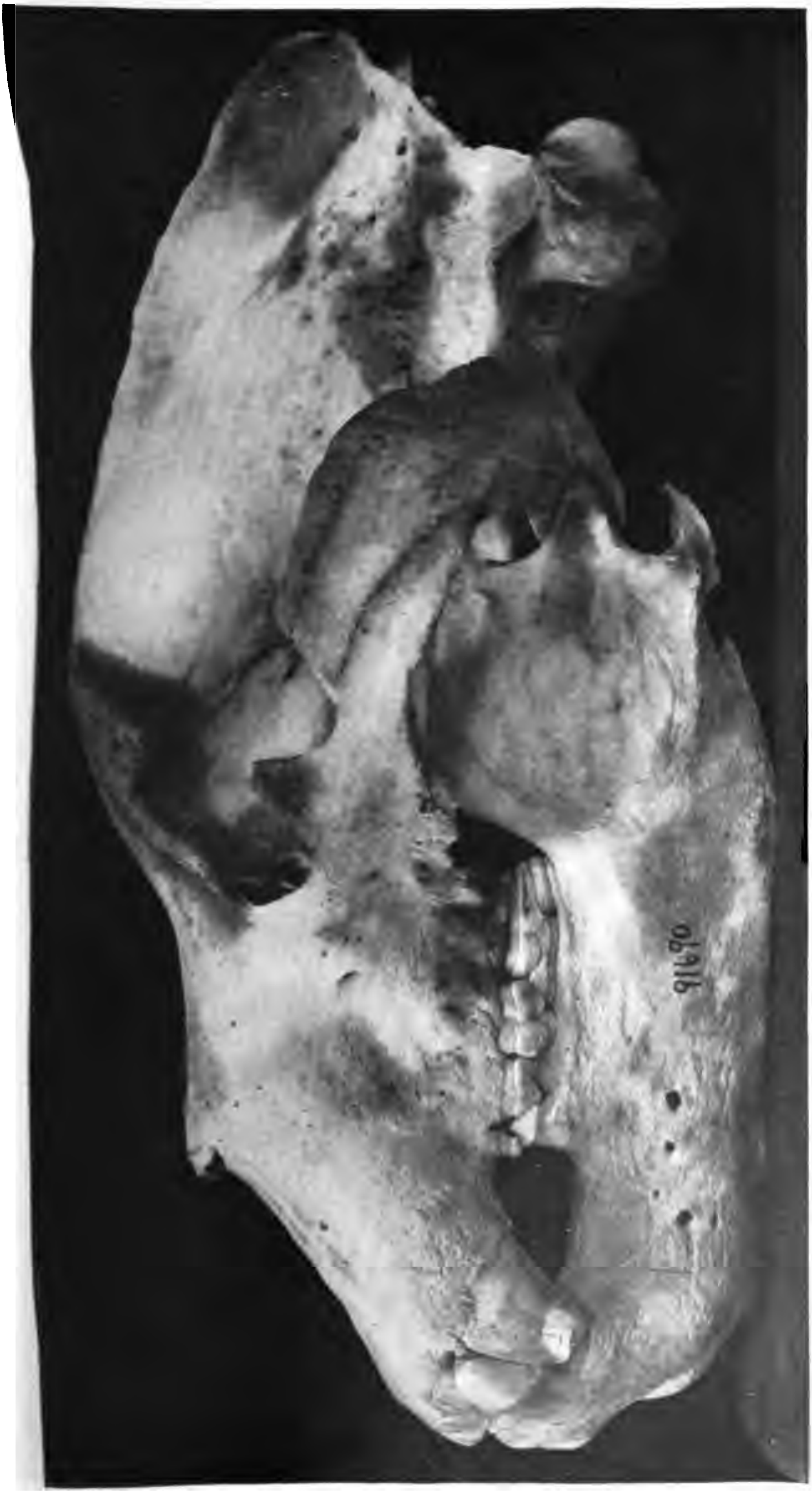
Type, skull No. 7149 (skin No. 8706), ♀ nearly adult, U. S. National Museum, from Rendezvous Lake, northeast of Fort Anderson, Mackenzie. Collected June 24, 1864, by R. MacFarlane. Original No. 1979. Teeth practically unworn.

Color.—General color varying from whitish buff to pale yellowish buff (yellowest on back of head and neck), darkening to dull reddish brown on ankles, feet, and median line of belly. The pale body color covers the entire body from between eyes to base of tail and reaches down over thighs and upper part of legs. Muzzle golden brown, becoming dull fulvous-brown around eyes; top of head from between eyes posteriorly soiled buff; long hairs of cheeks washed with buffy; ears pale buffy. Fur everywhere full, soft, and woolly; basal fur of upperparts varying from grayish to grayish brown, but distal half or more than half, pale buffy, so the animal as a whole appears to be buffy whitish.

Cranial and dental characters.—Skull small, moderately arched above; basicranial axis arched, palate strongly arched and slightly concave longitudinally. Teeth peculiar, presenting a combination of long canines and well-developed cusps for seizing (main cusp of PM^4 and $PM_{\bar{4}}$, outer cusps of M^1 and M^2 and anterior cusps of $M_{\bar{1}}$) with broadly flattened surfaces for crushing (in M^2, $M_{\bar{2}}$, and $M_{\bar{3}}$). Incisors, canines, and premolars as in *Ursus;* posterior molars peculiar, showing a strong tendency toward the suppression of cusps, particularly those of the inner side. Crown of M^1 with outer cusps (paracone and metacone) normal; inner cusps (protocone and hypocone—slightly worn) low, scarcely rising above level of median part of tooth; no middle cusplet. Crown of M^2 with outer cusps (paracone and metacone) normal; inner cusps (protocone and hypocone) obsolete, represented by a low ridge scarcely projecting above the granular surface of the interior of the crown. Crown of $M_{\overline{1}}$ normal, but anterior part higher than posterior. Crown of $M_{\overline{2}}$ very remarkable (see description of genus). Crown of $M_{\overline{3}}$ flat, with only insignificant marginal thickenings to represent protoconid and metaconid, the flat crown forming a direct continuation of the large crushing platform of the preceding tooth.

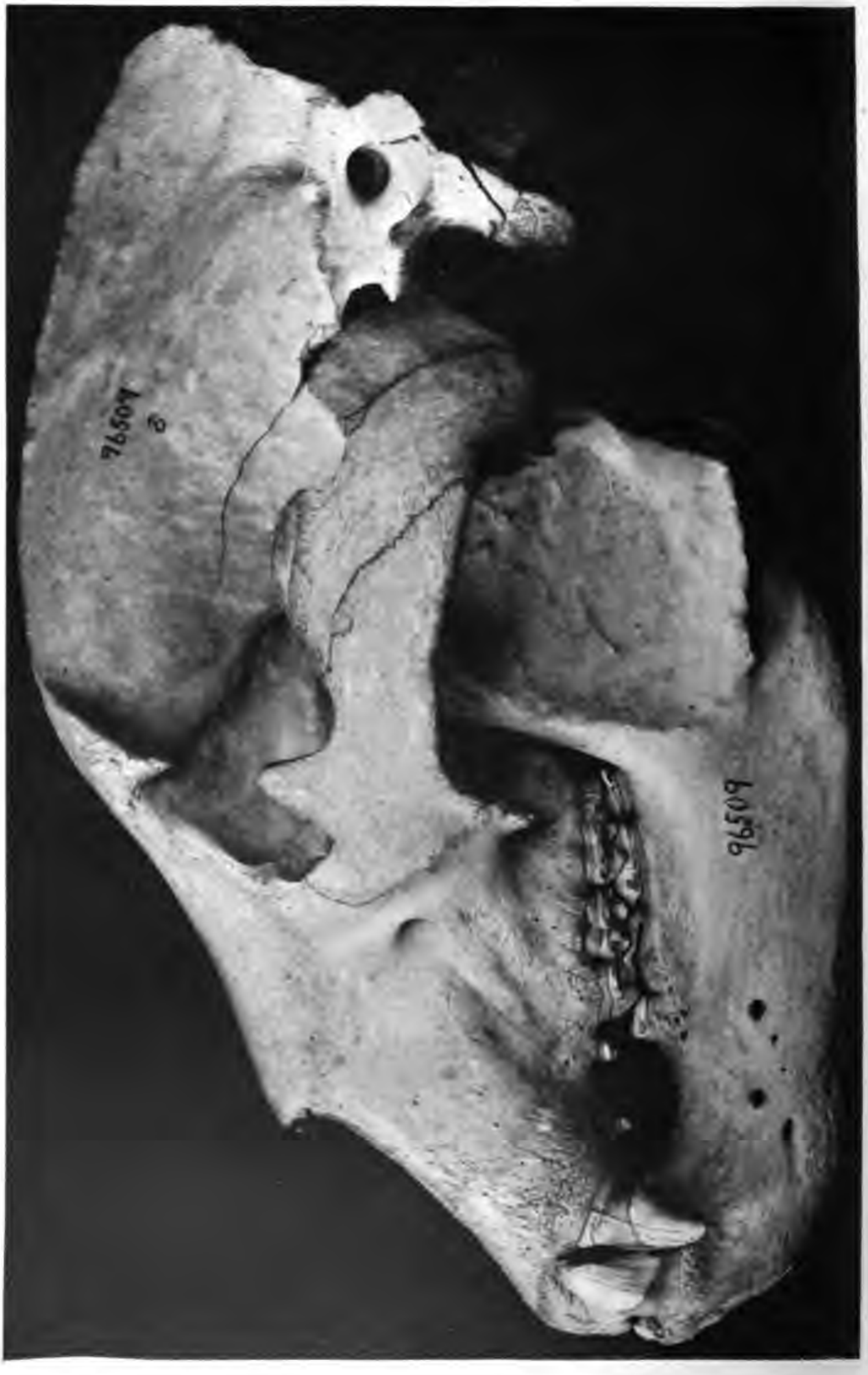
Skull measurements.—Young-adult female (type): Basal length, 268; occipito-nasal length, 255; palatal length, 148; zygomatic breadth, 181; interorbital breadth, 70.

Tooth measurements.—PM^4, 17 x 14; M^1, 22.5 x 17; M^2, 35.5 x 19; $PM_{\overline{4}}$, 14 x 8; $M_{\overline{1}}$, 24.5x12; $M_{\overline{2}}$, 27x17; $M_{\overline{3}}$, 21x16; upper molariform series, 73; upper molars, 59; lower molars, 72; diameter of lower canine, 13; upper incisors (series), 40.



SKULL OF URSUS GYAS.

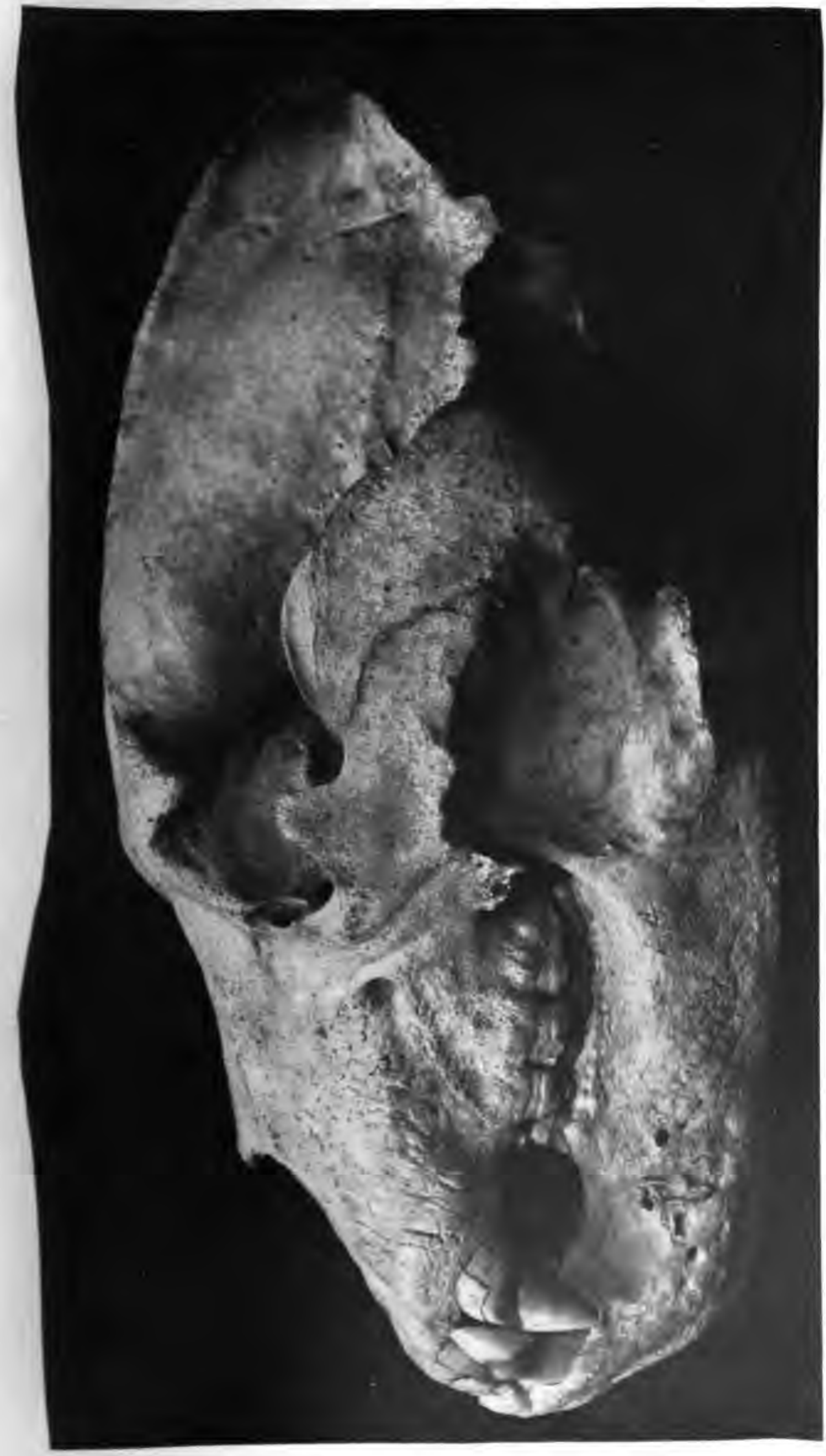
Old ♂ from Bear Bay, Alaska Peninsula. No. 91690. (Seven-sixteenths natural size.)



SKULL OF URSUS MIDDENDORFFI.

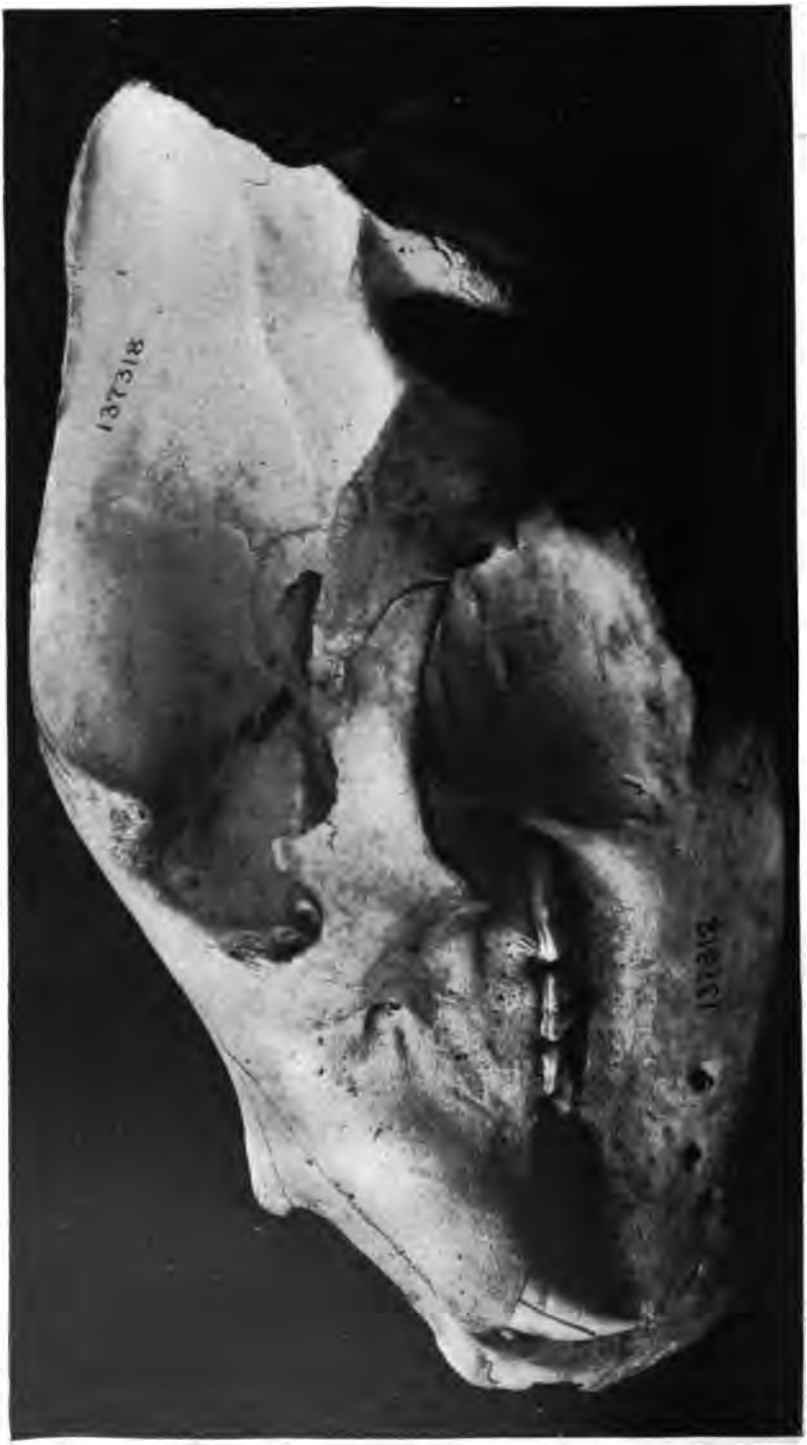
Old ♂ from Chiniak Point, Kodiak Island, Alaska. No. 96509. (Seven-sixteenths natural size.)

PLATE IV.



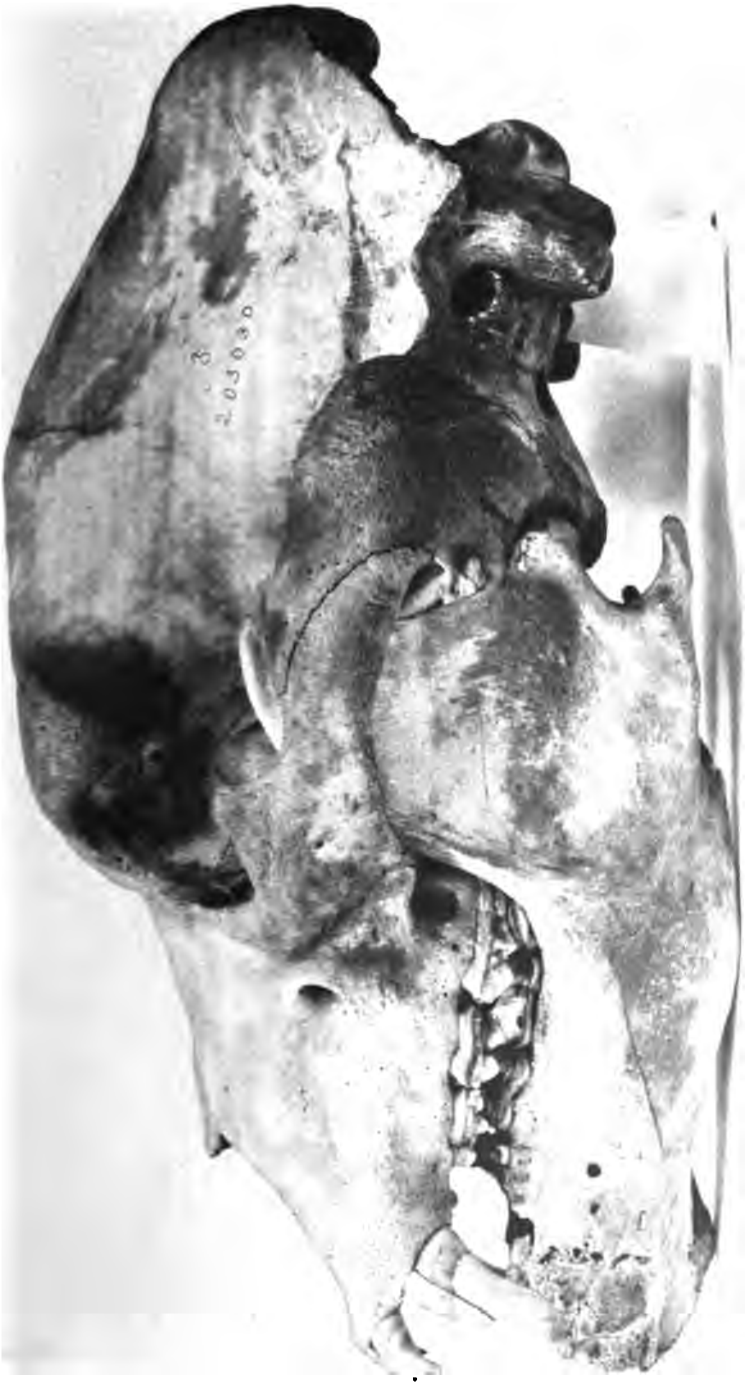
SKULL OF URSUS KENAIENSIS.

Old ♂ from Kenai Peninsula, Alaska. No. 210291. (Seven-sixteenths natural size.)



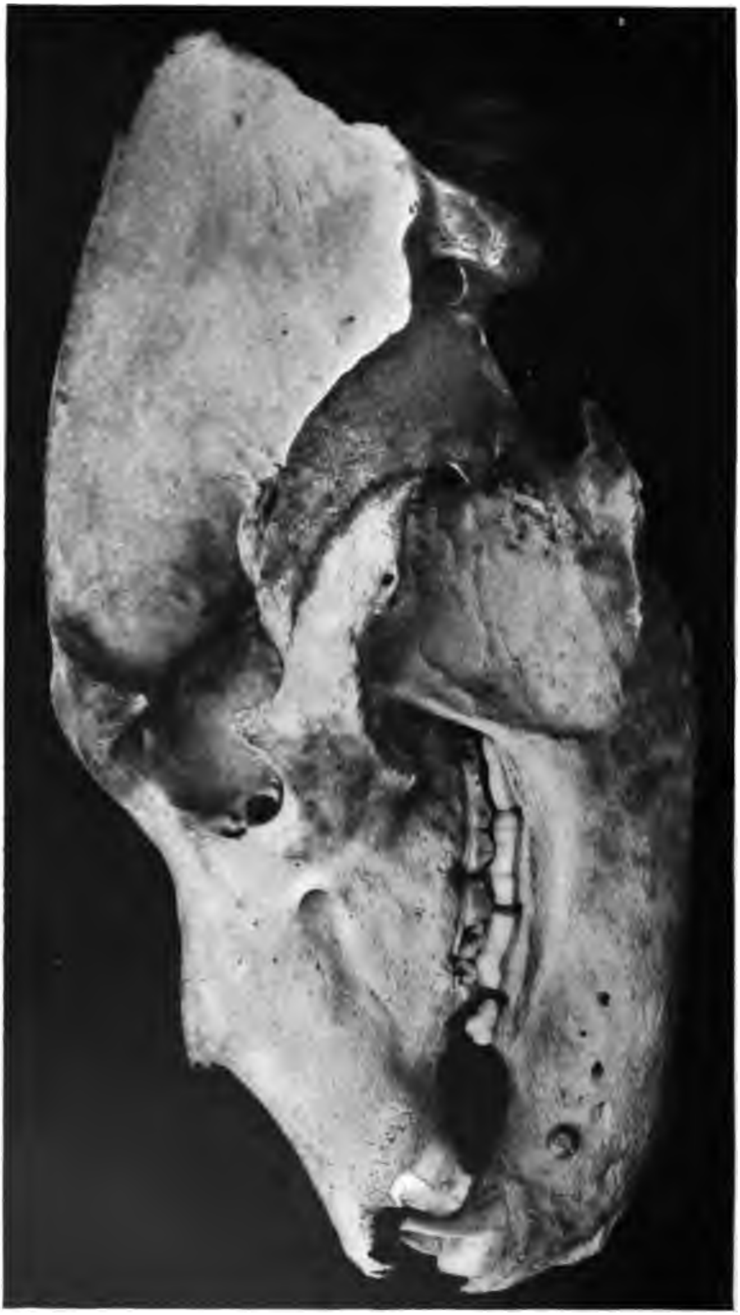
SKULL OF URSUS SHELDONI.

Adult ♂ from Montague Island, Prince William Sound, Alaska. No. 137318 (type). (Seven-sixteenths natural size.)



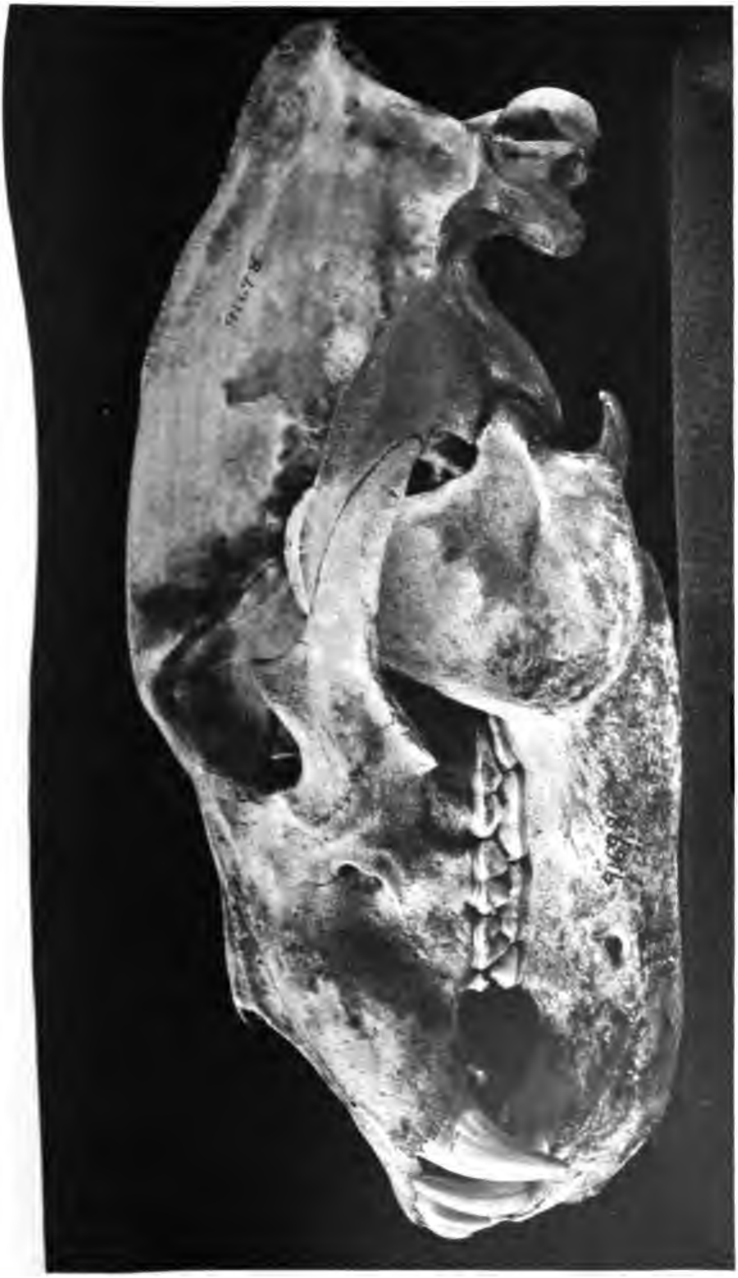
SKULL OF URSUS SHIRASI.

Old ♂ from Admiralty Island, Alaska. No. 203030 (type). (Seven-sixteenths natural size.)



SKULL OF URSUS INNUITUS.

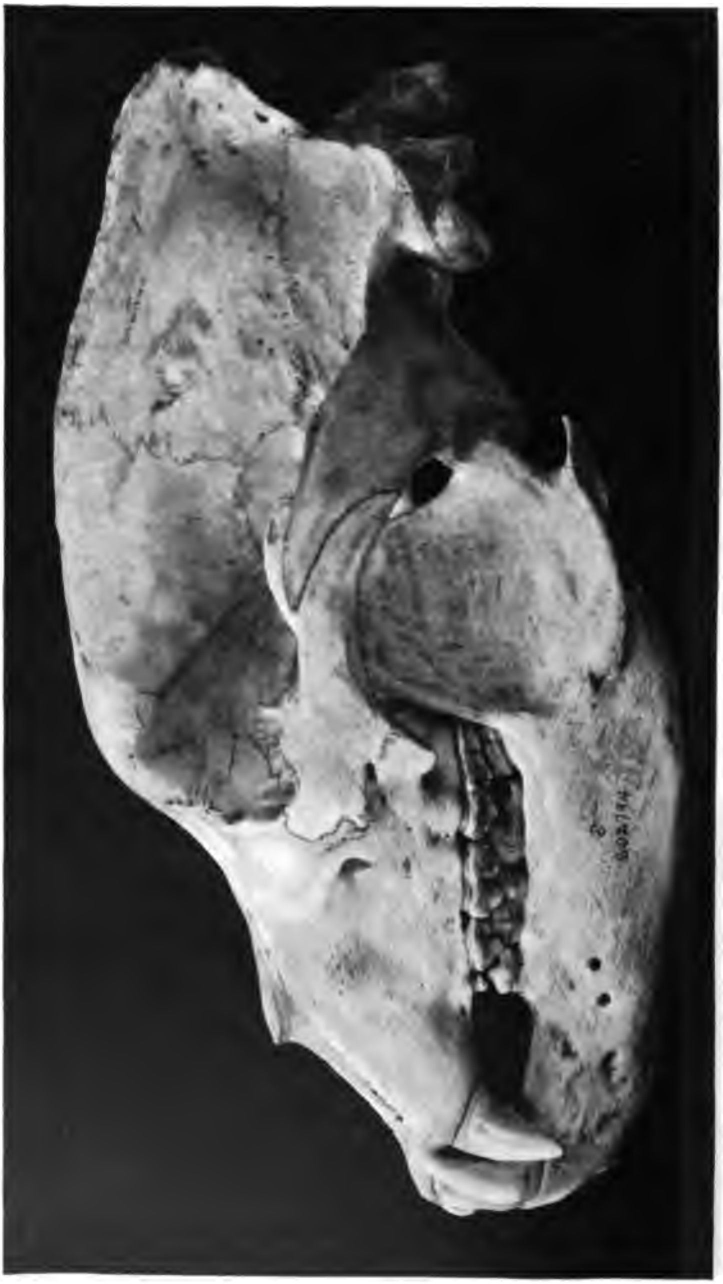
Old ♂ from Golofnin Bay, Alaska. No. 179780 (type). (Seven-sixteenths natural size.)



SKULL OF URSUS KIDDERI KIDDERI.

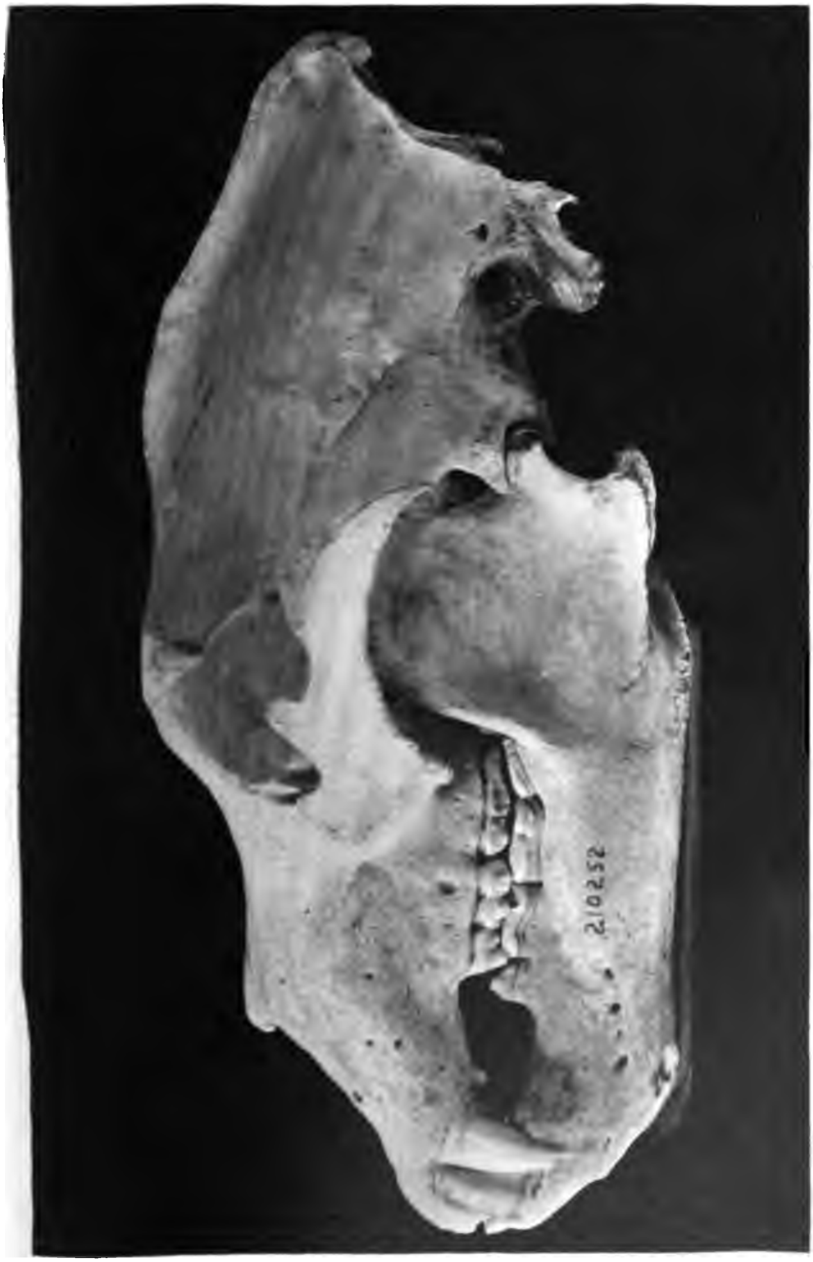
Old ♂ from Belkofski, Alaska Peninsula. No. 91698. (Seven-sixteenths natural size.)

PLATE IX.



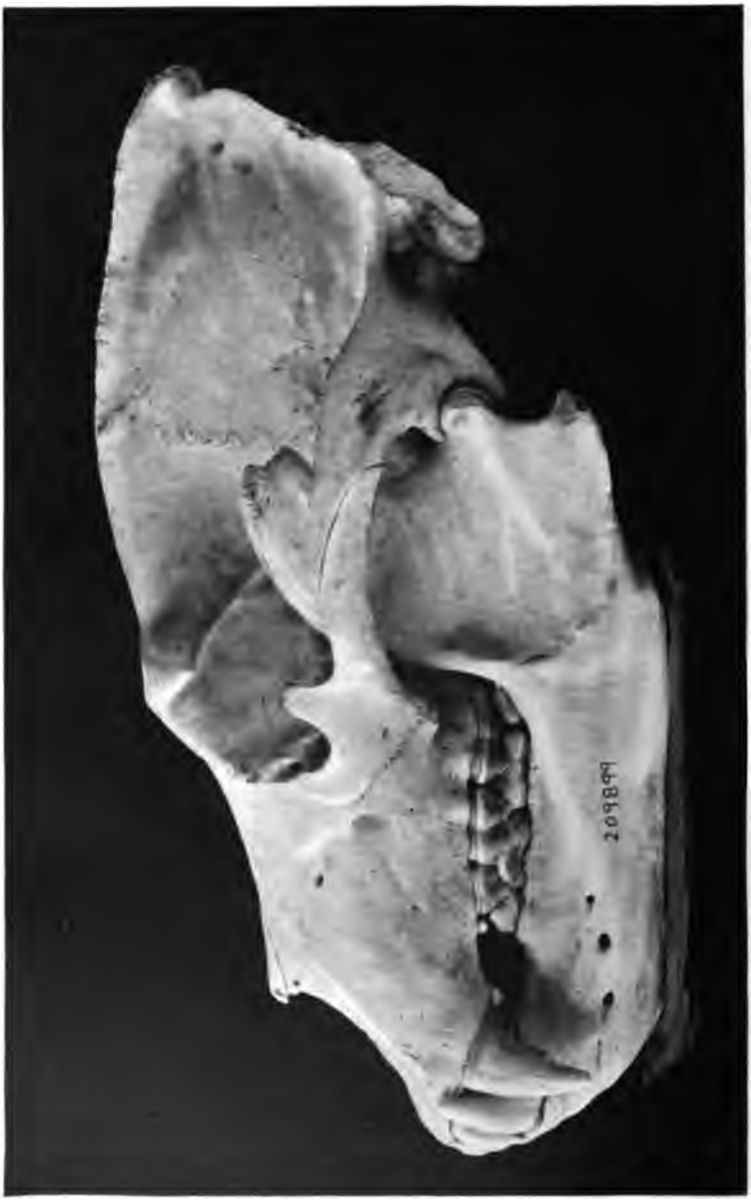
SKULL OF URSUS STIKEENENSIS.

Adult ♂ from Tatletuey Lake, near head of Skeena River, British Columbia. No. 202794 (type). (Seven-sixteenths natural size.)



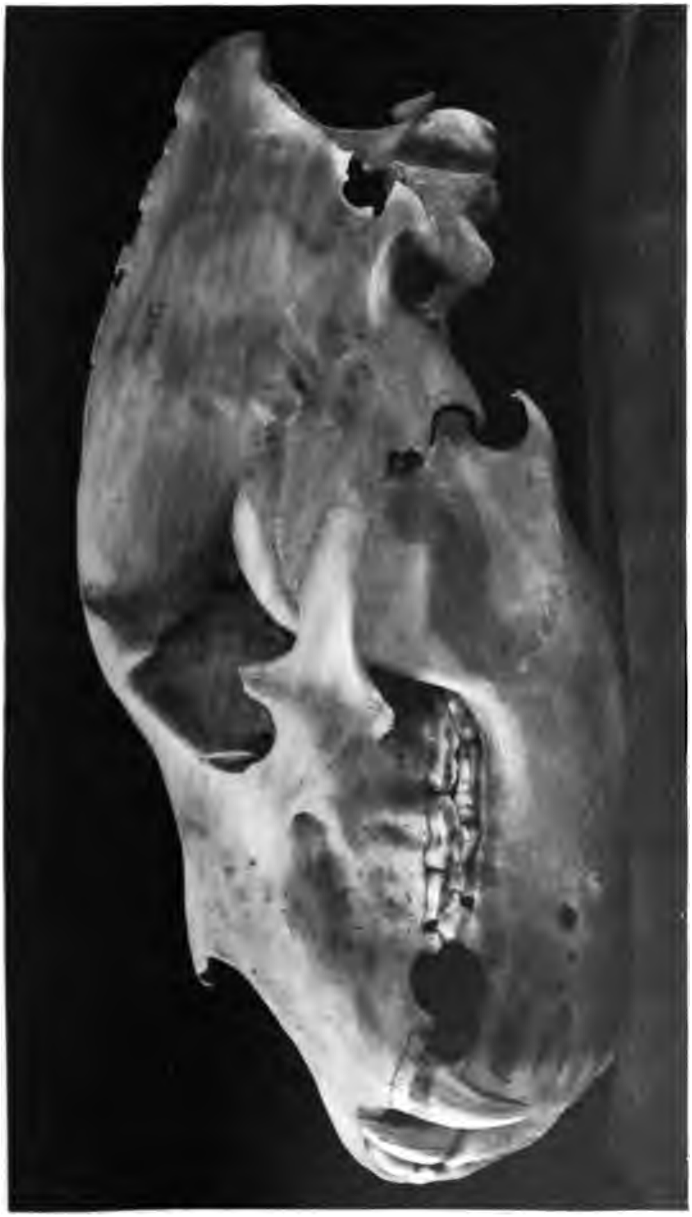
SKULL OF URSUS OPHRUS.

Old ♂ from eastern British Columbia. No. 210252 (type). (Seven-sixteenths natural size.)



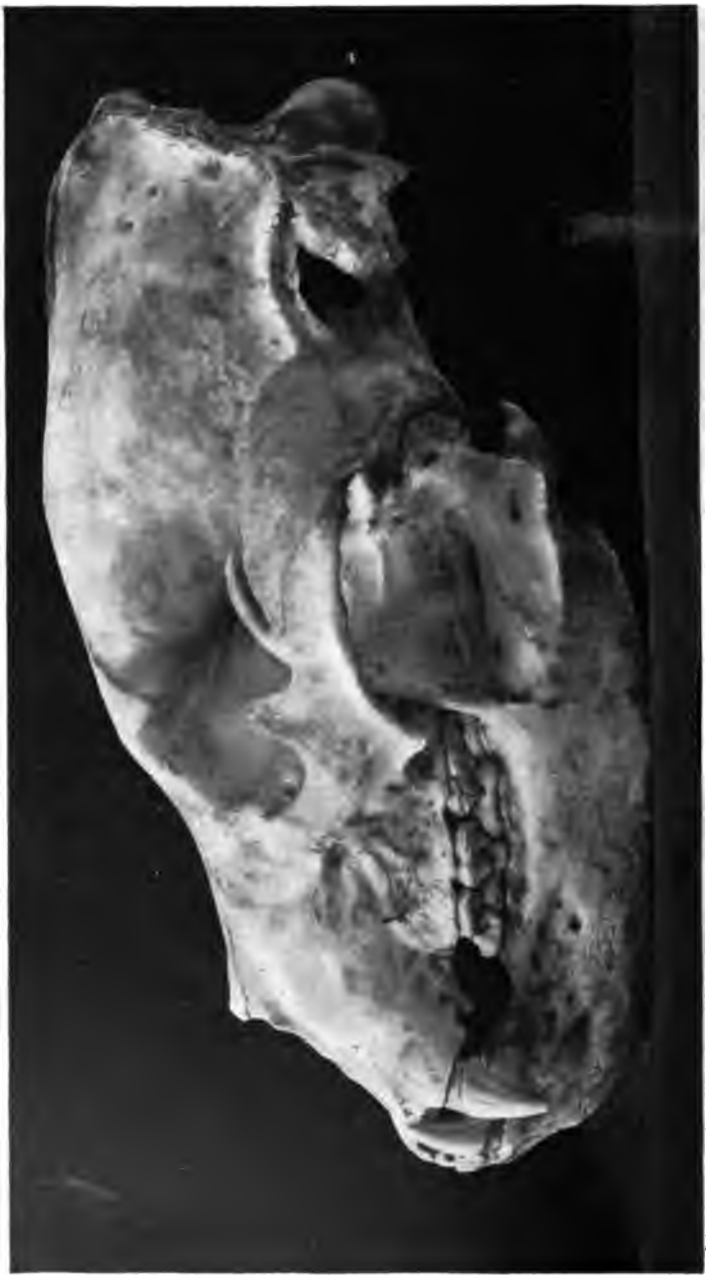
SKULL OF URSUS RUNGIUSI RUNGIUSI.

Old ♂ from Indian Point Creek, near Barkerville, British Columbia. No. 209899. (Seven-sixteenths natural size.)



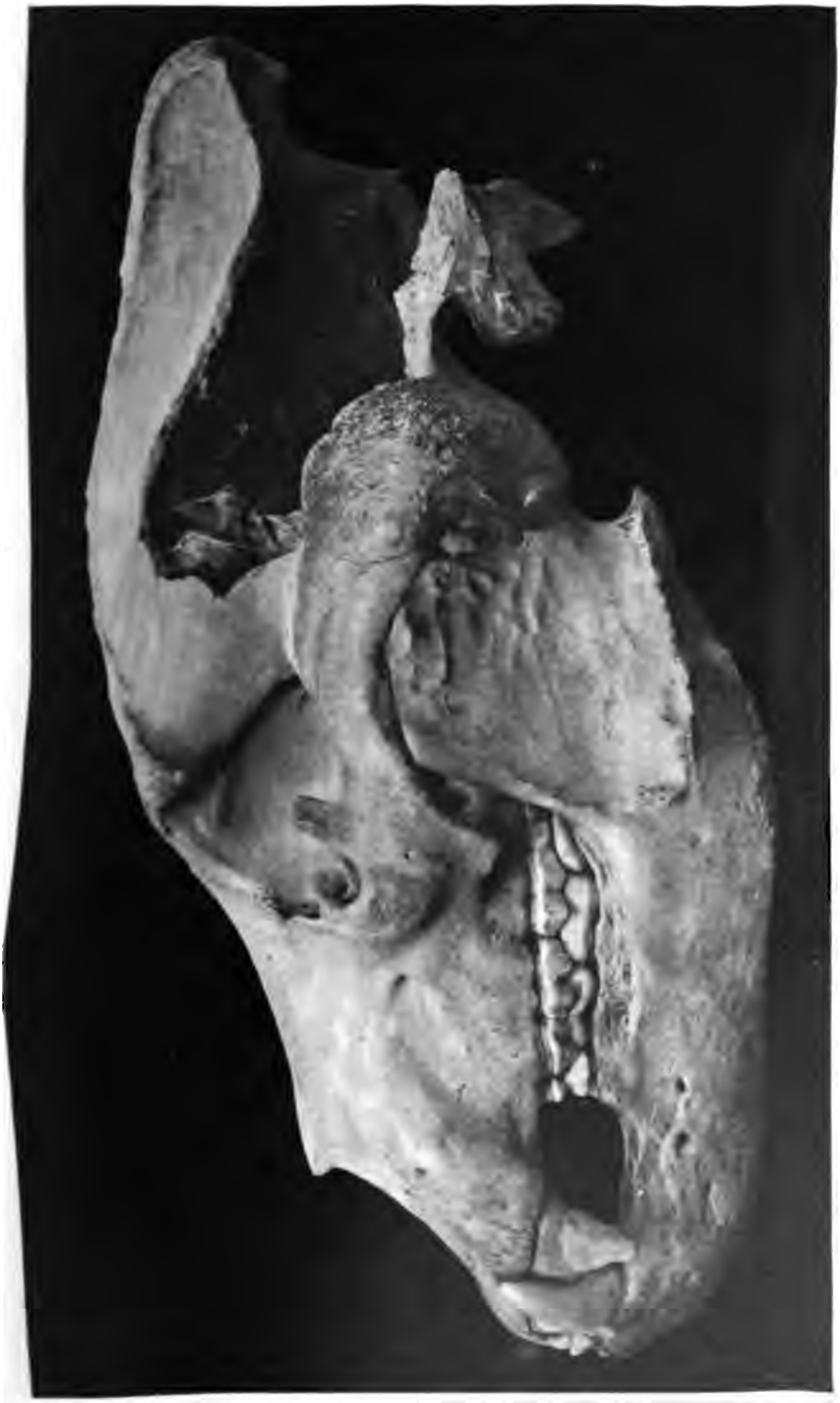
SKULL OF URSUS ALASCENSIS.

Old ♂ from Unalaklik River, Alaska. No. 76466 (type). (Seven-sixteenths natural size.)



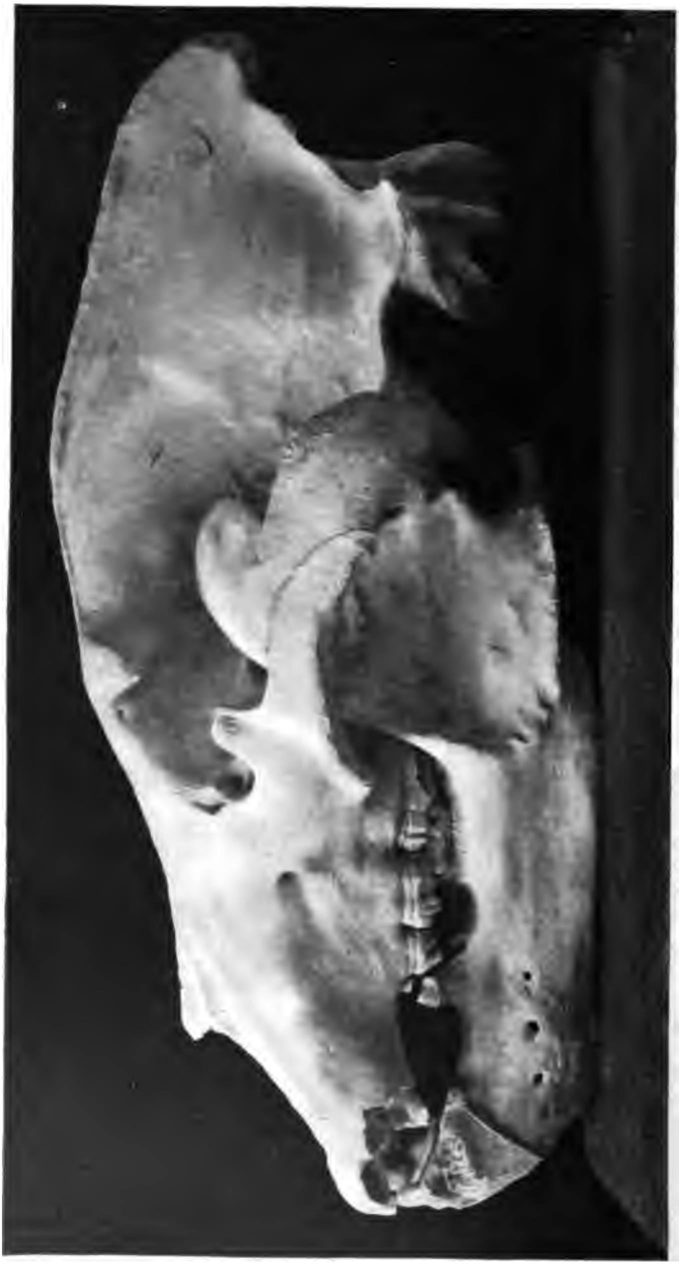
SKULL OF URSUS NORTONI.

Old ♀ from Yakutat, Alaska. No. 178763 (type). (Seven-sixteenths natural size.)



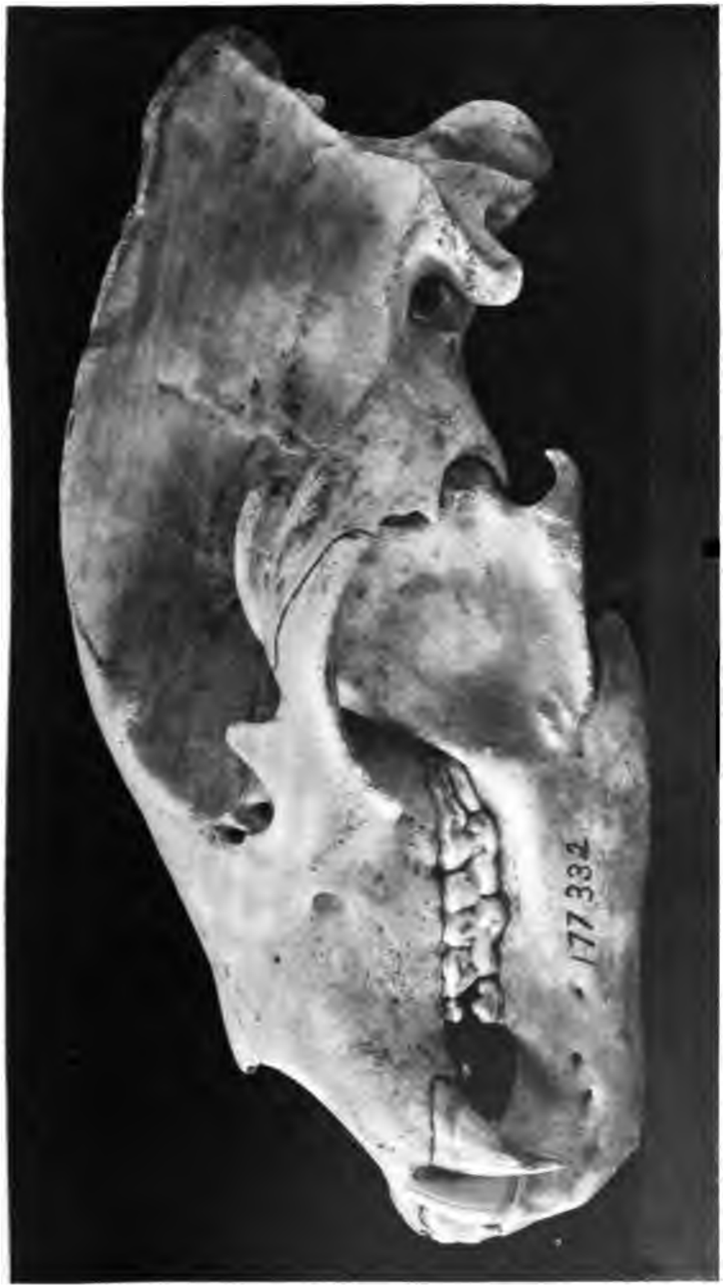
SKULL OF URSUS HORRIBILIS HORRIBILIS.

Old ♂ from Missouri Breaks, eastern Montana. No. 202739. (Seven-sixteenths natural size.)



SKULL OF URSUS HORRIÆUS.

Old ♂ from Coppermines, New Mexico. No. 990 (type). (Seven-sixteenths natural size.)



SKULL OF URSUS ARIZONÆ.

Adult ♂ from Escudilla Mountains, Apache County, Arizona. No. 177332 (type). (Seven-sixteenths natural size.)

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S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
E. W. NELSON, *Chief*

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ZONE INVESTIGATIONS IN WYOMING

BY

MERRITT CARY
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
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1917

LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., November 23, 1916.

Sir: I have the honor to transmit for publication as North American Fauna No. 42, a report on life zone investigations in Wyoming, by Merritt Cary, Assistant Biologist of the Biological Survey. The report is based on the results of natural history explorations conducted in recent years by Survey field parties in all the important physiographic areas of the State. The first section characterizes the five transcontinental life zones represented in Wyoming, defines their extent and limits, and discusses their economic possibilities. The second consists of notes on the distribution and abundance of conspicuous trees and shrubs observed during the progress of the survey. Of particular importance in connection with this report, as well as with others yet to be made on the distribution of the birds and mammals of Wyoming, is the accompanying map, which shows in detail the extent and boundaries of the life zones which traverse the State.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. David F. Houston,
Secretary of Agriculture.

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No. 42. NORTH AMERICAN FAUNA. Oct., 1917.

LIFE ZONE INVESTIGATIONS IN WYOMING.

By MERRITT CARY.

INTRODUCTION.

Wyoming is among the foremost of our States in its wealth of natural scenery, culminating in the grandeur of Yellowstone National Park, one of the wonders of the world. In addition to this distinction it posseses vast open plains and lofty mountains whence flow the headwaters of mighty river systems emptying far away to the west into the Pacific Ocean, to the southeast into the Gulf of Mexico, and to the southwest into the Gulf of California. The various slope exposures of its mountain ranges, the fertility of its intervening valleys or basins, and the aridity of its desert spaces present a study of geographic and vertical distribution of wild life that is in many particulars unique.

The study of geographic and vertical distribution of life with the governing factors and attendant problems is valuable as a matter of scientific research and in the attainment of practical knowledge. The Biological Survey has been making detailed investigations of the transcontinental life belts, or zones, of North America for some years, and this work has been carried on with special reference to their practical value. It has become increasingly evident that life zones furnish a fairly accurate index to average climatic conditions and, therefore, are useful as marking the limits of agricultural possibilities, so far as these are dependent upon climate. The knowledge thus gained has been published and made available as the investigations have progressed and the life zones have been mapped.[1]

The opening up to agriculture of the arid and semiarid West through irrigation and efficient methods of conserving the natural rainfall offers a favorable field for the practical application of this knowledge. A wide range of altitude and a correspondingly varied climate and physiography include from two to six of the major life zones in each of the several States, and the zonal boundaries are on the whole well marked by reason of the usually rapid or abrupt changes in elevation. New areas are continually being reclaimed, while in practically all the Western States large districts await future development. This is especially true of the Rocky Mountain States, where general agriculture has been least developed.

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[1] For detailed discussion and classification of the life zones of North America see Merriam, C. Hart, Life Zones and Crop Zones of the United States (Bull. 10, Biological Survey, U. S. Dept. Agr., 1898); also Bailey, Vernon, Biological Survey of Texas (North Amer. Fauna No. 25, 1905); Fourth Provisional Zone Map of North America, prepared by the Biological Survey, 1910; Cary, Merritt, Biological Survey of Colorado (North Amer. Fauna No. 33, 1911); and Bailey, Vernon, Life Zones and Crop Zones of New Mexico (North Amer. Fauna No. 35, 1913).

In Wyoming, agriculture has made rapid strides during the past few years, but it has not yet advanced much beyond the experimental stage, and the possibilities are somewhat limited by a cool climate due to high average base level. It appears unlikely that crop production will in future greatly exceed the local demand. There are, however, certain restricted areas of low elevation and moderate climate where a variety of crops and some of the hardier fruits have proved decidedly successful. A special value attaches to these low-lying districts inasmuch as they are immediately surrounded or bordered by extensive nonagricultural areas where mining, lumbering, and stock raising are the principal industries. The melting snows of Wyoming mountains furnish an unfailing supply of water for irrigation purposes, and Federal and private irrigation projects have already reclaimed considerable sections. Much valuable agricultural land in the valleys and basins awaits future development. Useless experimentation might be avoided or a more favorable location secured if the prospective as well as the resident agriculturist, and especially the horticulturist, would become familiar with the groups of native species of mammals, birds, reptiles, and plants which have proved to be closely associated with the areas of successful production of particular crops in other parts of the arid West.

Natural history explorations carried on in recent years by the Biological Survey in all the important physiographic areas of Wyoming warrant the present report on the life zones with the accompanying map (Pl. I). Sufficient material has been gathered also for inclusion of notes on the distribution of conspicuous trees and shrubs and for later reports on the mammals and birds of the State.[1]

---

[1] The present report combines the results of field investigations for the Biological Survey conducted at various times by Dr. C. Hart Merriam, Vernon Bailey, B. H. Dutcher, J. Alden Loring, Edward A. Preble, Alexander Wetmore, H. E. Anthony, Stanley G. Jewett, and D. D. Streeter, jr.; besides those made by the author since 1909 (see map of Wyoming, showing routes of field parties, fig. 1). Lists and other publications bearing on the distribution of the Wyoming fauna and flora, although few in number, have been freely consulted. For identification of many of the plants collected in the survey the author is indebted to Dr. J. N. Rose and Paul C. Standley, of the U. S. National Herbarium, and to F. V. Coville, curator of the National Herbarium, who has named the *Ribes*. The few reptiles and amphibians collected have been identified by Dr Leonhard Stejneger, of the U. S. National Museum.

PHYSIOGRAPHY AND CLIMATE.

In common with other States of the Rocky Mountain region, Wyoming has a varied physiography and climate and great natural resources. The surface features may be classified broadly as mountains, plains, and valleys or basins.

The continental watershed formed by the main chain of the Rockies enters the State through Yellowstone Park near the mid-western boundary of the forested plateau and maintains a general southeasterly trend along the lofty crests of the Absaroka and Wind River Ranges, lowering in the Red Desert region to arid plains and alkaline basins at 7,000 feet elevation, but again rising to the summits of the Sierra Madre, where it crosses the southern boundary of the State near its middle point. This watershed divides the Great Plains from the Great Basin, and on its slopes in northwest Wyoming rise the headwaters of the Colorado in Green River, the Columbia in Snake River, and the Missouri in Yellowstone and Madison Rivers.

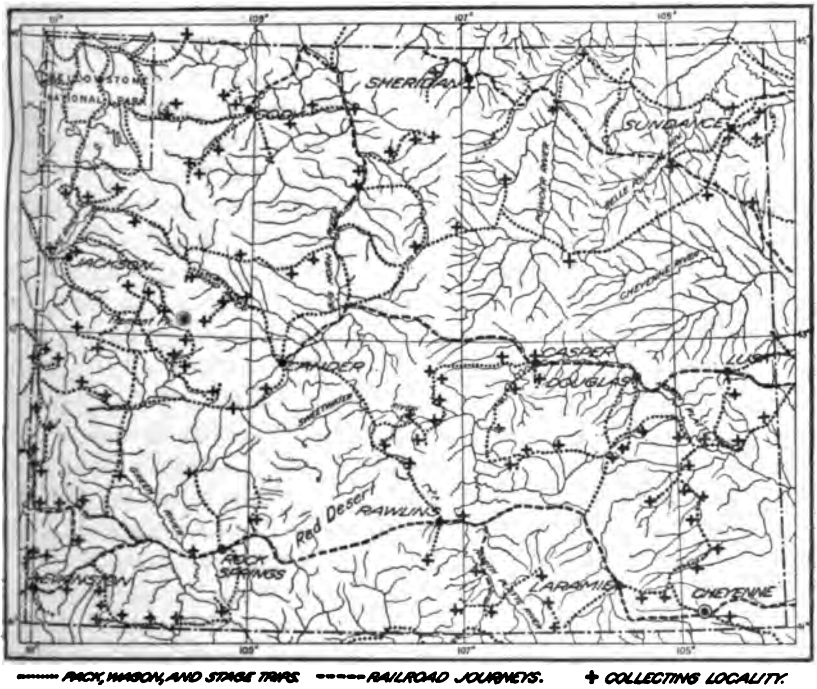

FIG. 1.—Map of Wyoming showing routes and collecting localities of Merritt Cary and other members of the Biological Survey, mainly from 1909 to 1915.

The mountains of Wyoming, massed largely in the northwest, occupy approximately a fourth of the total area. Chief among them are the Absaroka, Wind River, Gros Ventre, and Teton Ranges in the northwest; the Bighorn Mountains in the central northern portion; and the Sierra Madre and the Medicine Bow Ranges at the south. Most of these are heavily forested groups of great elevation, whose summits and crests reach far above timberline and are usually snow capped even in midsummer. All belong to the Rocky Mountain system except the Bighorn Mountains, which alone are detached from the main chain. Gannett Peak in the Wind River Mountains, at 13,785 feet, is the highest point in the State, exceeding the height of its close neighbor, Fremont Peak (13,730 feet); and of the Grand Teton (13,747 feet) in the Teton Range.

The Ferris, Green, Seminole, Shirley, and Rattlesnake Ranges are small separated groups along the upper Platte and Sweetwater Valleys and in the northern borders of the Red Desert, lying a little east of the continental watershed but indicating the general course of the Rockies. These differ greatly in configuration, but are usually characterized by densely forested northern slopes and summits and abrupt barren southern exposures facing the desert. In this region also are the huge bare granite heaps and domes rising from the sandy plain north of the Sweetwater, known collectively as the Granite Mountains. Together, these small ranges are a pleasant relief to a generally barren landscape.

The southwest corner of Wyoming is much broken by the northern timbered shoulders of the Uinta Mountains and by barren elevated ridges and mesas on either side of Green River and east of Bear River. In the southeast the Laramie Mountains are a foothill spur of the Medicine Bows continuous north to the Laramie River Gap and thence in more broken formation extending to the Platte Valley near Casper. Conspicuous groups of outlying hills at the east and northeast are the pine-clad Hartville Mountains north of Guernsey and the densely forested Black Hills and Bear Lodge Mountains.

Although well supplied with mountains, Wyoming is perhaps better known for its vast open plains. These are either level or rolling, lying mainly between 4,500 and 7,000 feet elevation, and are distinguished by characteristic types of vegetation, as the sage plains of the high, arid, interior plateaus; and the grassy plains to the east and northeast, which are part of the Great Plains. These treeless expanses were ranged long before historic times by great bands of buffalo, and, succeeding these, by countless herds of cattle and sheep, and their great grazing value is well attested by the long and bitter warfare for their possession between cattle barons and flockmasters which marked the days of the open range. At present dry farming is greatly restricting the cattle range on the Cheyenne and Lusk Plains and elsewhere along the eastern edge of the State. The extensive arid sage plains farther west, however, are mainly utilized for sheep grazing, to which they are peculiarly adapted.

The numerous valleys of Wyoming are well watered, and with their rich soils and low elevations (chiefly below 5,000 feet) include the areas of greatest agricultural importance and promise. Most important are those of the North Platte, Laramie, Cheyenne, Belle Fourche, Powder, Bighorn, Wind, Sweetwater, and Green Rivers.[1] The Bighorn and Wind River Valleys are extensive basins of low altitude and mild climate, well suited to the production of certain fruits and other crops. The more elevated valleys of the Sweetwater and Green Rivers are mainly devoted to stock raising.

The Red Desert is an extensive barren alkaline plain or basin of great aridity lying mainly west of the continental watershed in the southern part of the State. Without perennial streams and with soils strongly alkaline, it would appear to have no agricultural future. Alkali-resistant desert shrubbery and the moderate winter climate of this region nevertheless combine to furnish an excellent winter range for sheep, and it has long been thus utilized by flockmasters.

Wyoming's lowest elevation is in the extreme northeast, and its highest is in the northwest. Plains and plateaus occupy much of its southern half. The altitudinal extremes are 3,100 feet (approximate), where the Belle Fourche River crosses the eastern boundary; and 13,785 feet, on the summit of Gannett Peak in the Wind River Range.

The climate of the State is mainly arid, the rainfall ranging from 12 to 15 inches in the semiarid eastern Great Plains area to under 10 inches in the extreme arid central desert region (Bighorn Basin[2] and Red Desert). A heavier precipitation in the Bear Lodge and Black Hills districts at the northeast (15 to 20 inches) admits of tolerably successful agriculture without irrigation. The high timbered mountain ranges receive a great deal of moisture, not only as winter snows, but also during summer as frequent heavy, dashing rains.[3]

The elevated base level of Wyoming (about 6,000 feet) insures a generally cool climate. Warm summers (mean summer temperature about 65° F.) with a long growing season and moderate winters with light snowfall are the rule only at the lower levels in the north and east. The high interior valleys, plains, and plateaus are marked by short, cool summers (mean summer temperature about 55° F.), with prevalent late spring frosts, and by long winters with tolerably heavy snowfall and frequent cold winds. The snowfall is excessive in the mountainous country of the northwest, where occasionally very low temperatures are recorded,[1] but the winter season as a whole is perhaps less severe than on the high wind-swept plains.

---

[1] Most of the valleys are treated in some detail under their respective zones.

[2] The lowest parts of the Bighorn Basin often receive less than 6 inches of annual rainfall.

[3] The precipitation usually given for the mountains is over 18 inches, but data are lacking for the higher altitudes, where it must be much greater.

For a State with an arid climate Wyoming is exceptionally well watered, and among its natural resources none is more essential to its future development than its rivers and streams. The Snake, Yellowstone, Bighorn, and Green Rivers rise in the mountains of the northwest; the Tongue, Powder, Belle Fourche, and Cheyenne Rivers, with their numerous tributaries, head in the Bighorn Mountains and the elevations of the northeast; while the North Platte and Laramie Rivers, which describe long, circuitous courses in the southeastern part of the State, have their sources in the high ranges of Colorado.

LIFE ZONES OF WYOMING.

Wyoming has a generous representation of animal and plant life. This is largely due to the varied climate resulting from a difference in altitude within its borders of nearly 10,700 feet; and in a lesser degree to a difference in latitude of 4 degrees, and a wide range of local physiographic conditions.

The life zones range from Upper Sonoran (the western arid subdivision of the Upper Austral Zone) at the lowest and warmest elevations, through the Transition, Canadian, and Hudsonian, to the Arctic-Alpine Zone on the crests of the highest mountain ranges. Of the seven North American transcontinental life zones, only the Lower Sonoran and the Tropical are unrepresented; and the Upper Sonoran Zone, while covering large areas, is represented only by its upper, cooler part.

The five zones present in Wyoming are briefly characterized as follows: *Upper Sonoran*, the zone of broad-leaved cottonwood, juniper, saltbush, and yucca, occupying most of the valleys and low plains; *Transition*, the zone of yellow pine, narrow-leaved cottonwood, and pure sagebrush, embracing the high plains, the basal slopes of the mountains, and all except the highest foothills; *Canadian*, the Boreal forest belt of spruce, fir, lodgepole pine, and aspen, covering the middle mountain slopes and highest foothill ranges; *Hudsonian*, the narrow zone or belt of white-barked pine and dwarfed spruce and fir, in the timberline region; and *Arctic-Alpine*, the treeless zone, on mountain crests and peaks above timberline.

Zonal boundaries and sequence usually are well marked on ranges rising abruptly from a low base, as on the western slope of the Bighorn Mountains, where a vertical interval of about 9,500 feet may be traversed in 15 or 20 miles; and on the Wind River Range southwest of Lander. Under gradual change in altitude, however, as on the open plains, the passage from the Upper Sonoran to the Transition Zone is often scarcely noticeable, and in mapping zones generally the limits in many places must be more or less arbitrarily fixed. In a survey of native mammals, birds, reptiles, and plants made at a given locality, a marked preponderance of characteristic species of a zone decides the zonal position; while a nearly equal representation, or a marked absence, of species peculiar to two adjoining zones is indicative of an intermediate position, or the approximate boundary.

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[1] —45° F. is sometimes recorded in Jackson Hole, and though data are lacking, still lower temperatures undoubtedly are reached on the high ranges.

The several zones occupy areas of great irregularity in Wyoming owing to the very broken configuration, and their vertical boundaries are subject also to the usual variation resulting chiefly from differences in latitude, base level, and slope exposure. In general, zone levels are lowest in the north because of lower base and higher latitude, and highest in the south where the base level is more elevated.[1]

UPPER SONORAN ZONE.

The arid subdivision of the Upper Austral Zone, the Upper Sonoran, occupies nearly a third of Wyoming (about 30,000 square miles), and covers all the lower levels. Fully half this area lies below 5,000 feet altitude in the eastern and northern sections, and most of it is well characterized. On the high plains and deserts of the south the Sonoran element is present between 5,500 and 6,500 feet elevation, mainly in dilute form. Low altitude, a warm climate and long growing season, and extensive open, level, or gently rolling areas of rich soils combine to make the Upper Sonoran the chief zone of crop production, dependent as in other sections of the arid West upon careful conservation and distribution of the natural water supply. All areas adapted to any extent to horticulture lie within this zone and, because of its agricultural importance, the limits and characterization are somewhat detailed.[1]

The Upper Sonoran areas of Wyoming are mainly broad extensions of the zone from lower elevations on the south, east, and north. Those entering from the south comprise a narrow strip of desert valley along both sides of Green River north nearly to Labarge; and in the Red Desert a broad region of barren plains and alkaline depressions which reaches eastward to include a small area in the upper Platte Valley both north and south of Fort Steele. The above areas are narrowly connected along Bitter Creek, and more broadly over the Snake River Valley in northwest Colorado, and together they form the northernmost extensions of the important Green River Upper Sonoran area.

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[1] For detailed boundaries of the zonal areas of Wyoming see the zone map (frontispiece).

Two large tracts of Upper Sonoran country in the east are part of the Great Plains area. The southernmost of these is approximately bounded on the west by the 5,000 to 6,000 foot basal plains flanking the Laramie and Hartville Mountains, and extends north to the narrow strip of Transition Zone along the northern escarpment of the Lusk Plains. In the North Platte Valley the zone continues narrowly through the canyons above Guernsey, then in greater width to Casper, and in dilute character to the Seminole Mountains and to Splitrock in the Sweetwater Valley. North of the Lusk Plains the Upper Sonoran Zone includes most of the Cheyenne River drainage lying between the pure sage plains of the northern central section and the yellow pine country of the Black Hills. The Belle Fourche Valley in the northeast also carries a narrow Upper Sonoran strip around the northern and western bases of the Bear Lodge Mountains, which widens above Moorcroft and extends nearly to the Pumpkin Buttes.

A broad band of this zone entering the State from the north along the Bighorn River and Clarks Fork covers a large extent of low-altitude country in the arid Bighorn and Wind River Basins below 5,500 or 6,000 feet elevation. These two areas, of which the Bighorn Basin is the larger and agriculturally the more important, are narrowly connected through the canyon south of Thermopolis, but are otherwise separated by the elevated Transition Zone ridge of the Owl Creek Mountains. East of the Bighorn Mountains, the valleys of the Tongue, Powder, Little Powder, and Little Missouri Rivers carry narrow tongues of Upper Sonoran Zone some distance into the State, separated more or less widely by low, open or pine-clad Transition Zone watersheds.

In Wyoming, as in other States traversed by the continental watershed, the Upper Sonoran Zone is best treated under its two main subdivisions, the *Great Plains* and the *Great Basin*.

Great Plains Division—Upper Sonoran Zone.

Great uniformity of surface features and characterization marks the Great Plains area from the Dakotas to Texas and west to the eastern foothills of the Rocky Mountains. It is a vast level or undulating region of abundant grasses and moderate rainfall, entirely open except along streams, which are usually fringed with deciduous trees and shrubbery, and also in the rougher parts near the foothills where

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[1] The subdivisions are based upon differences in climate, configuration, and native species, and are not to be confused with the physical Great Plains and Great Basin areas as generally understood and with which they are not coextensive. The imperfect characterization of the Great Basin division in Wyoming, particularly as regards its mammal and bird life, is due to high altitude, and in the Red Desert region in part to the infusion of Great Plains species as a result of the continuity of the Sonoran areas on either slope of the Continental Divide.

junipers and pines often occur in scattered growth. Areas of firm soils alternate with tracts of sandhills or rolling sandy country, and as the foothills are approached there are scattered areas of rough bad lands, the bluffs along streams become rocky, while numerous talus ridges, and clay, chalk, or rock buttes of usually irregular but in some places of strikingly symmetrical outline, stand up from the plain (Pl. II). The important streams of the Great Plains have their sources in the Rocky Mountains and course through valleys usually shallow and often sandy, which show little erosion. This type of country is well marked along the eastern edge of Wyoming as far north as Lusk.

The greatest elevation of the Upper Sonoran Zone is in the south, where on the firm-soil plains of the Cheyenne region it becomes dilute at 5,500 feet elevation, and its upper limits are indicated at approximately 6,000 feet, chiefly by absence of characteristic species. Exact delimitation is difficult on these open grassy plains, which extend on a gradual incline to the 7,000-foot base of the Laramie Mountains. The Cheyenne Plains descend steadily northward to the Platte Valley at a little over 4,000 feet, the surface meanwhile becoming broken and the soil sandy. The Sonoran element is very pronounced in the warm valleys of the Platte drainage, as in the Chugwater Valley below Bordeaux; in the Laramie Valley at Wheatland, Jetsam, and Uva; in Rawhide Valley below Patrick; in Goshen Hole; and along the North Platte below Guernsey; and agriculture under irrigation in these districts is correspondingly successful and varied.

North of the Platte Valley, and jutting squarely against the eastern bases of the Hartville Mountains and the Rawhide Butte, is an extensive grassy plateau with an elevation of from 4,800 to 5,000 feet, extending east into Nebraska and breaking sharply at the north toward the Cheyenne River. Upper Sonoran species predominate up to 5,000 feet, but the region is near the upper edge of the zone, since rocky buttes, ridges, gulches, and cool northern declivities carry a scrubby growth of yellow pine, Rocky Mountain juniper, red currant, mountain mahogany, and other Transition Zone vegetation. This plateau, often known as the Lusk Plains, is characterized mainly by its luxuriant growth of nutritious grasses and has long been noted as choice cattle range. Extensive areas on both the Cheyenne and Lusk Plains are now utilized in dry farming, to which the soil and climate are well adapted.

Characteristic associations of Upper Sonoran species mark the lower portions of the Cheyenne and Lusk Plains and the North Platte Valley. Large groves of broad-leaved cottonwoods (chiefly *Populus occidentalis*) are on the North Platte and Laramie Rivers and especially on Sibylee Creek, while in addition to cottonwoods the usual fringe along streams consists of willows, box elder, ash,[1] flowering currant, and wolfberry. Common shrubs or shrubby plants on dry flats, in gulches, and on rocky or gravelly slopes are saltbush, rabbit brush, narrow-leaved sagebrush, yucca (Pl. III), bush morning-glory, sand cherry, and skunk bush.

Some of the most conspicuous and characteristic flowering plants are *Eriogonum annuum*, *Rumex venosus*, *Abronia elliptica*, *Argemone intermedia*, *Cleome serrulata*, *Polanisia trachysperma*, *Lupinus plattensis*, *Astragalus crassicarpus* and *A. mollissimus*, *Psoralea* (spp.), *Petalostemon* (spp.), *Linum rigidum*, *Croton texensis*, *Mentzelia decapetala*, *Opuntia polyacantha*, *Mamillaria vivipara* and *M. missouriensis*, *Anogra albicaulis*, *Meriolix serrulata*, *Lithospermum gmelini*, *Lippia cuneifolia*, *Verbena hastata* and *V. bracteosa*, *Physalis lanceolata*, *Solanum rostratum*, *Pentstemon angustifolius*, *Plantago purshi*, *Liatris punctata*, *Grindelia squarrosa*, *Ratibida columnaris*, *Helianthus annuus* and *H. petiolaris*, *Hymenopappus filifolius*, *Carduus plattensis*, and *Lygodesmia rostrata*.

Mammals which especially mark this region as Upper Sonoran are the Kennicott ground squirrel, prairie-dog, Great Plains grasshopper mouse, prairie harvest mouse, Colorado bushy-tailed wood rat, Hayden field mouse, yellow pocket gopher, sage pocket gopher, Wyoming kangaroo rat, Kansas pocket mouse, Bailey cottontail, black-footed ferret, northern plains mole, and California bat.

Characteristic breeding birds of the plains are the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, bronzed grackle, lazuli bunting, lark bunting, western grasshopper sparrow, western lark sparrow, white-rumped shrike, yellow warbler, long-tailed chat, western mockingbird, catbird, and brown thrasher.

Reptiles are poorly represented on the plains of eastern Wyoming. The few conspicuous snakes and lizards include the plains rattlesnake, prairie bull snake, hog-nosed snake, blue racer, garter snakes, desert horned lizard, sand swift, scaly lizard, six-lined lizard, and many-lined skink.

The Upper Sonoran area north of the Lusk Plains is open, but much rougher in configuration, and the shrubby type of vegetation becomes increasingly prominent, especially in the valleys below 4,500 feet elevation, where the Sonoran element is strongest. Grass and cactus flats alternate with tracts of sagebrush, rabbit brush, and greasewood over much of the drainage basin of Cheyenne River, and in the low Belle Fourche and Little Missouri Valleys in northeast Wyoming. The watersheds between the valleys are either ranges of rolling grassy hills or abrupt barren ridges of bad lands of about

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[1] Uncommon.

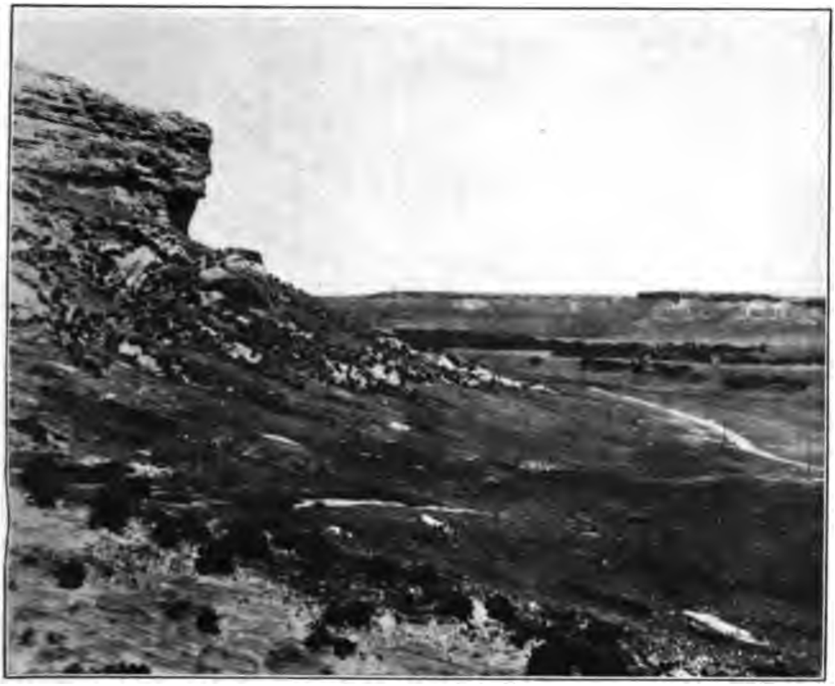

FIG. 1.—CHUGWATER VALLEY BELOW CHUGWATER.
Juniper and mountain mahogany (*Cercocarpus parvifolius*) on bluffs, and box elders in valley.

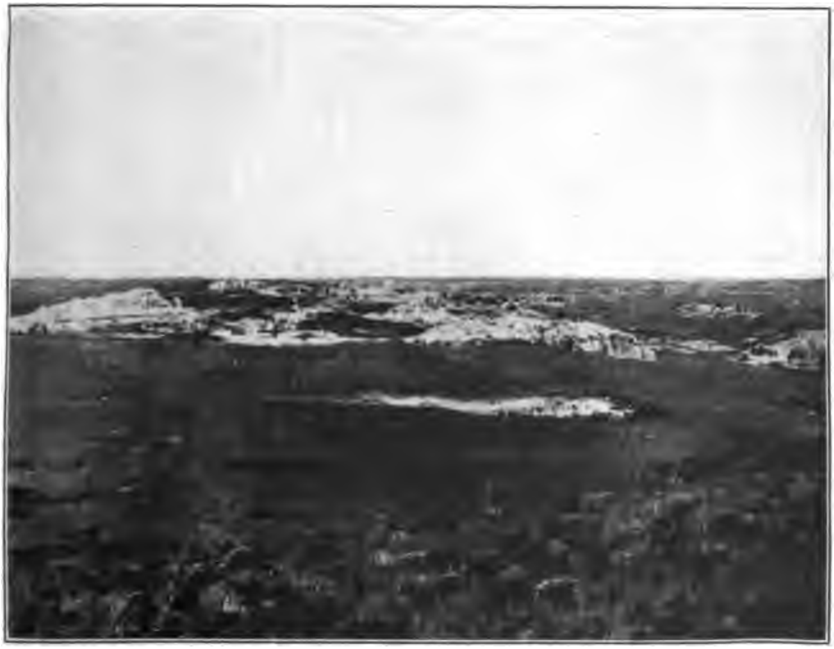

FIG. 2.—WESTERN EDGE OF GREAT PLAINS AREA.
Scattered yellow pines and junipers in butte country southwest of Guernsey (4,800 feet).

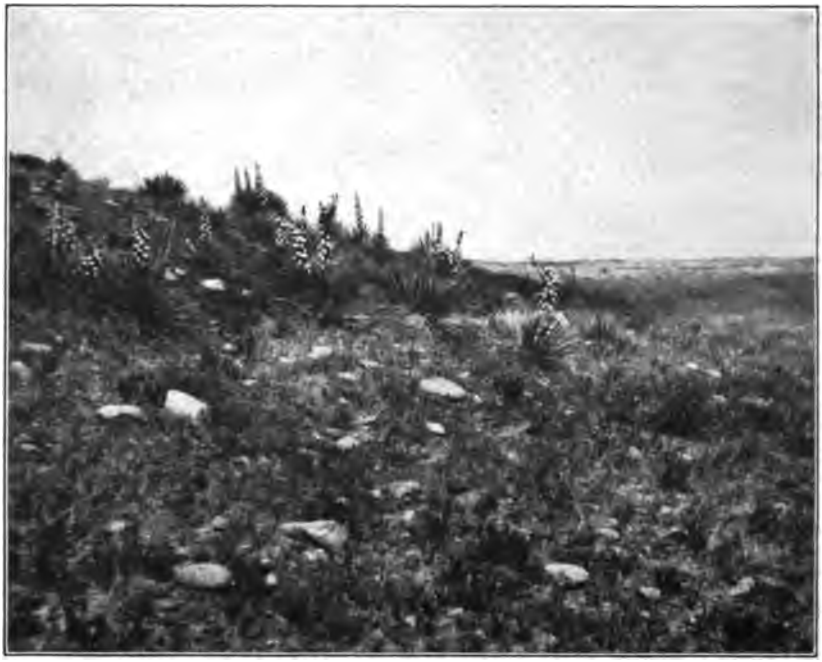

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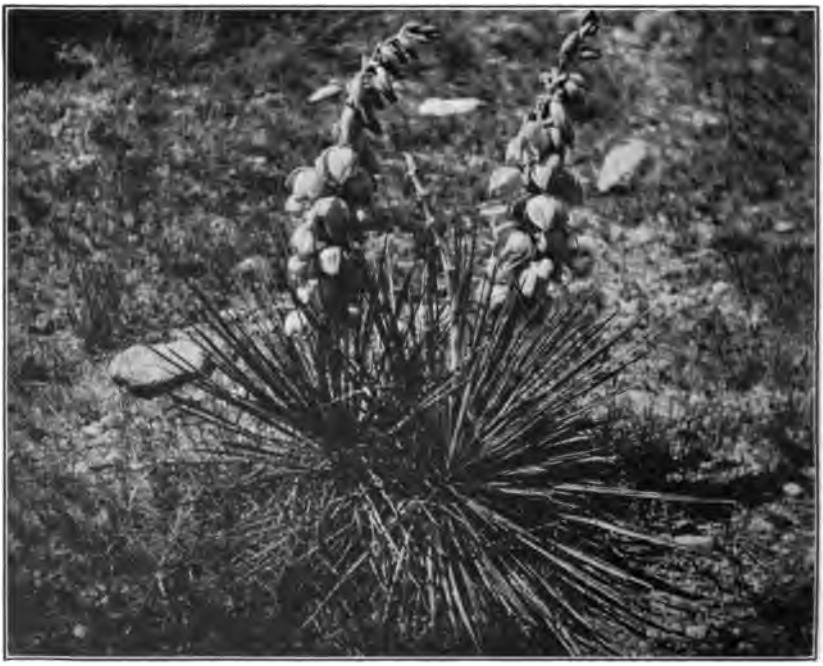
FIG. 1.—PLAINS YUCCA (YUCCA GLAUCA) IN FLOWER IN CHUGWATER VALLEY NEAR BORDEAUX, JULY 1, 1909.



[illegible]

FIG. 2.—NEARER VIEW OF SAME.

5,000 feet elevation. Extensive breaks with more or less yellow pine, juniper, and Transition Zone shrubbery margin the Cheyenne River basin, especially on the south, while the watercourses usually are bordered narrowly with gnarled cottonwoods, willows, box elders, and other deciduous trees and shrubs, as along plains streams generally.

Sagebrush country rapidly takes the place of grassy plains west of Lusk, varied in the upper valley of the Platte with greasewood, rabbit brush, saltbush, and other desert shrubbery, which becomes increasingly common westward. Shrubby Sonoran vegetation fills also most of the narrow extensions of the Yellowstone Valley Upper Sonoran Zone in the valleys of the Little Powder, Powder, and Tongue Rivers east of the Bighorn Mountains.

Although the shrubby type of desert vegetation, more barren surface, and greater aridity of the upper Platte Valley, and the Upper Sonoran areas between the Black Hills and Bighorn Mountains, would seem to place them with the Great Basin division of the zone, their mammals, birds, and herbaceous plants are mainly those of the Great Plains. Species which are absent or rare on the plains farther south include among plants the greasewood, black sagebrush, several species of rabbit brush, white sage, saltbushes, and stanleya; and among mammals, the Maximilian and Sweetwater pocket mice.[1]

Upper Sonoran areas of eastern Wyoming are within the semiarid region and receive in most sections a mean annual rainfall of from 12 to 15 inches. This is sufficient for a luxuriant growth of the best varieties of range grasses in all sections with suitable soils, but will not admit of agriculture apart from irrigation or dry-farming methods, except possibly around the base of the Black Hills, where the precipitation is a little greater. Under irrigation the rich alluvial soils of the valleys yield abundant crops, while the moderate returns from the soil secured most years in the dry-farming communities scattered over the plains are inducing a steadily increasing settlement of these districts.

Great Basin Division—Upper Sonoran Zone.

The Green River Valley, Red Desert, and the Bighorn and Wind River Basins have a barren surface which shows everywhere much erosion, especially along the larger streams, which in many places flow through rugged canyons. These open interior areas of from 4,000 to 6,500 feet elevation lie within the arid region of slight rainfall, and the scanty vegetation is of the shrubby, bunchlike, desert type so characteristic of the Great Basin region as a whole (Pl. IV, fig. 2), in marked contrast with the grassy plains of eastern Wyoming. A narrow fringe of scattering junipers usually marks the upper border of the zone on the rough lower margins of these desert valleys and basins, while considerable areas of junipers with scattering pinyons partly fill the upper part of the zone in lower Green River Valley, and in the extreme southwestern borders of the Red Desert.[1] The Great Basin division is better characterized in Wyoming by vegetation and climate than as a faunal region,[2] although a few Great Basin species of both mammals and breeding birds occur in the Green River Valley and on the Red Desert. The mammals and birds of the Wind River and Bighorn Basins are mainly those common to the Great Plains.

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[1] A number of mammals and birds and a few plants found commonly on the Lusk Plains and southward do not reach this region.

The great dearth of rainfall in these desert areas precludes ordinary agriculture and even dry farming. Effective agriculture is therefore possible through irrigation alone.

GREEN RIVER VALLEY—UPPER SONORAN ZONE.

The Upper Sonoran area extending north along Green River nearly to Labarge is considered apart from the Red Desert, with which it is connected, on account of different topographic features and a stronger characterization in its lower part, near the Utah boundary, where the elevation is only 5,800 feet in the river valley. In this section it is a rough incised region of rocky, juniper-clad ridges and dry, open canyons or narrow valleys reaching gradually down to Green River from high, bordering Transition Zone hills and mesas; and of precipitous, brightly colored canyons whose various shades of red and yellow are in strong contrast with the intense black of the juniper ridges. The steep, hot, protected slopes of this broken canyon region carry the Upper Sonoran Zone regularly as high as 7,000 feet.

Its species are characteristic of the juniper and pinyon belt of the Great Basin, but are in less variety than in this part of the zone farther south, and some of them reach but a short distance into the State. Junipers, scattering pinyons, mountain mahogany, shadscale, syringa, and cactuses comprise the principal vegetation on ridges and dry slopes; saltbushes, grayia, yellow cleome, eriogonum, and cactuses are common shrubs and plants on the open sand or adobe flats in the valleys between the ridges; the skunk bush and flowering currant form characteristic shrubbery on the bluffs immediately along Green River; while extensive flats in the wider parts of the river valley are densely covered with greasewood (Pl. IV, fig. 1) and glasswort in damp, alkaline spots.

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[1] The belt of junipers and pinyons, which in regions farther south is usually present in good width and characterizes the upper part of this division of the zone, is but poorly indicated in Wyoming, where the zone is more often open throughout.

[2] See footnote, p. 14.

The gray titmouse, Baird wren, and pinyon jay are common birds in the juniper growth, and probably breed, as does also the sage sparrow, on the greasewood flats. Among the characteristic Upper Sonoran mammals of this region are the least and rock chipmunks, golden-breasted canyon mouse, True's cliff mouse, Green River pocket gopher, and Great Basin spotted skunk. The reptiles and amphibians include the plains rattlesnake, scaly rock lizard, Stansbury sand lizard, short-horned lizard, and the spadefoot toad.

North of the canyon region, which extends to within 15 or 20 miles of the town of Green River, the Upper Sonoran Zone spreads out in dilute form to include the lower valleys of the Black Fork and Big Sandy, connecting eastward through the Bitter Creek drainage with the larger area on the Red Desert.[1] As a narrowing strip along Green River it continues to the warm valley flats between Fontenelle and Labarge. This is an open, deeply eroded region of barren valleys and bench lands, of bare mesas and variously colored bad lands, buttes, and bluffs, whose zonal position is best defined by its conspicuous vegetation, chiefly that common to the Red Desert. Upper Sonoran species of mammals and breeding birds are comparatively few in number in this high part of the zone, where saltbushes, grayia, small brown sagebrush, rabbit brush, and other desert shrubbery, and such plants as yellow cleome and stanleya give way to the pure sage and rabbit brush plains of the Transition Zone at about 6,500 feet elevation.

The Green River Valley is rather bleak and inhospitable and does not seem to invite agricultural development. In character it resembles the Red Desert in many ways, but is less intensified, particularly in the aridity and the alkalinity of its soils. Owing to erosion, there is little valley land, and this little is partly used in the cultivation of forage crops. At the north a limited agriculture is possible, wherever lands can be brought under irrigation, on the small areas of bench lands which lie along Green River and its few permanent side streams. The rainfall is insufficient for a good growth of forage grasses, yet large numbers of sheep subsist upon the desert shrubbery and scanty grass. Sheep grazing appears to be the most practicable industry, and the rough character of lower Green River Valley, with its many sheltered canyons, warm protected slopes, and mild climate, peculiarly fits it for a winter range.

RED DESERT—UPPER SONORAN ZONE.

Fairly constant surface features obtain over the open elevated region of undulating plains and alkaline depressions or basins, known as Red Desert, which is particularly characterized by great aridity, saline or other strongly alkaline soils, and dearth of permanent surface water. The only relief to the general monotony and barrenness is in scattering buttes, occasional ranges of low hills, bluffs along dry washes, or summits of distant bordering hills and mountains. The impression of barrenness is only intensified by the prevalent dull greenish gray or occasional light-gray hues of desert shrubbery.[1] The continental watershed extends across the north-central portion at an elevation of less than 7,000 feet where lowest, being crossed by the Union Pacific Railroad at Creston at 7,000 feet. Eastward the altitude decreases slightly toward the North Platte Valley (6,500 feet), and westward slopes through its only conspicuous drainage area, Bitter Creek Valley, to 6,000 feet on Green River. The climatic features are hot sunny days, cool nights, very slight rainfall during a short summer, and a long, moderately open winter. The heaviest snows are often in spring and are more beneficial to vegetation than summer rains, which are either largely lost through rapid evaporation or, in the case of the occasional heavier showers, quickly run off the barren slopes and fill the dry gulches with muddy torrents. Frosts are not uncommon during the height of the growing season.

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[1] See frontispiece (map).

Dilute Upper Sonoran Zone, poorly characterized apart from vegetation, covers the lower portion of the Red Desert to 6,500 or 6,800 feet altitude, a total area of between 5,000 and 6,000 square miles, including the North Platte Valley from the Platte Canyon to above Fort Steele. The conspicuous and dominant vegetation is Upper Sonoran desert shrubbery—the various species of saltbush, the white sage, greasewood, grayia, kochia, rabbit brush, the black sagebrush,[2] and low desert sages; with scattering desert junipers on many of the bluffs. A willow (*Salix fluviatilis*) is not uncommon on creeks of the Bitter Creek drainage. Such plants as prickly-pear cactus, yellow cleome, stanleya, many alkali-resistant members of the goosefoot family, and scattering grasses, conspicuous among which are wheat grasses and giant rye-grass, are abundant and characteristic.

The small striped ground squirrel, pocket mice, long-eared bat, least chipmunk, Green River pocket gopher, kangaroo rat, Bailey cottontail, and Great Basin spotted skunk are Upper Sonoran mammals inhabiting the Red Desert.

The variety of bird life is very limited, and few characteristically Sonoran birds breed here. The sage sparrow and western lark sparrow are perhaps most nearly restricted to the zone. Other birds found in abundance during the breeding season, the Brewer sparrow, thick-billed redwing, western meadowlark, western nighthawk, sage thrasher, and white-rumped shrike, breed also on the surrounding sage plains of the Transition Zone.

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[1] The name "Red Desert," originally applied to a restricted area of reddish soil along the Union Pacific Railroad, does not convey a correct impression of this region as a whole, where desert vegetation instead of soil lends the characteristic colors.

[2] Abundant also in Transition Zone.

This arid, barren waste is naturally unsuited to human habitation. Not only do the extensive alkaline deposits in the desert basins tend to make soil conditions over large areas unsuitable for crops, but even the underground water over practically the entire region is strongly alkaline and unfit for use. These conditions, combined with a deficient rainfall and absence of perennial streams, give no promise of an agricultural future. The few ranches are situated mainly along the skirts of the desert, where a number of small creeks coursing down from higher country furnish sufficient water for small fields and garden patches before being lost in the sand. Others are found at the few widely separated springs which rise in different parts of the desert. A ready and remunerative market for garden truck is furnished by the large coal-mining town of Rock Springs, and trucking is carried on in that district wherever there is sufficient water for irrigating a small garden patch.

The chief value of the Red Desert, aside from the extensive coal fields in its western part, is as a winter range for the hundreds of thousands of sheep which spend the summer on the higher plains and in the hills and mountains of central and western Wyoming. The abundant sagebrush, greasewood, and saltbushes, particularly the Nuttall saltbush (see Pl. IV, fig. 2) and other alkali-resistant shrubs and plants, afford an abundance of winter forage,[1] while plenty of water for stock is insured by the snows which drift before the frequent winds and permit browsing in the cleared spaces. Its peculiar adaptation to the winter feeding of sheep, long appreciated by the flockmasters, gives the Red Desert region a special importance as a necessary complement to one of Wyoming's great industries.

WIND RIVER BASIN—UPPER SONORAN ZONE.

The Upper Sonoran area drained by Wind River and its affluents lies mainly between 5,000 and 6,000 feet elevation. It extends from the southern escarpment of the Owl Creek Mountains to the northeastern base of the lofty Wind River Range, and at the east and southeast to the broad tract of high, rolling, sagebrush plains which separate it from the Upper Sonoran areas along the Platte and on the Red Desert. In its surface features, climate, vegetation, and animal life this region is generally similar to the Bighorn Basin, with which it is connected narrowly through the rugged canyon which cleaves the Owl Creek Mountains and carries the waters of the

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[1] For a full discussion of the pasture value of the alkaline desert basins see Nelson, The Red Desert of Wyoming and its Forage Resources, Bull. 13, Div. of Agrostology, U. S. Dept. Agr., 1898.

Bighorn. The greater elevation of the Wind River Basin results, however, in a weaker characterization of the zone, while extensive areas of rough bad lands, which fill much of the upper (western) part between Wind River and the Owl Creek Mountains and form in many places the watersheds between streams elsewhere, greatly restrict the agricultural lands and confine them largely to the valleys. Owing to its proximity to the mountain mass of the Wind River Range, the western edge of this area receives more moisture than the central and eastern portions. where the rainfall seldom exceeds 10 inches.

The Upper Sonoran element is most pronounced in the lower valleys below Riverton, and on the plains and bad lands which jut against the southern bases of the Owl Creek Mountains. The vegetation on the sandy plain north of Shoshoni is typical of the lower elevations generally, consisting of saltbush, greasewood, rabbit brush, small brown sagebrush, spiny sagebrush, yucca, and prickly-pear cactus, with skunk bush and juniper on bluffs, and broad-leaved cottonwood, buffaloberry, flowering currant, and wolfberry along streams. Along the eastern base of the Wind River Range and on the barren slopes and gulches of the higher bad lands dilute Upper Sonoran Zone reaches to nearly 6,000 feet altitude, and here, as well as on the southern side of the Owl Creek Mountains, includes the fringe of scattering junipers which is more or less evident on the margins of the open basin. The effect of slope exposure on zone level is especially noticeable on the warm southern slopes of the Owl Creek Mountains, where the zone is carried regularly to 6,500 feet, at least 500 feet higher than on the cooler basal slopes of the Wind River Mountains, on the opposite side of the basin.

The generally weak character of the Upper Sonoran Zone over the Wind River Basin is evident from the paucity of characteristic zone species of mammals and breeding birds, which include, among mammals, the pale chipmunk, Great Plains grasshopper mouse, kangaroo rat, Bailey cottontail, Great Basin spotted skunk, and California bat; and among birds, the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, western lark sparrow, white-rumped shrike, and long-tailed chat. The plains rattlesnake and the desert short-horned and scaly rock lizards are the most noticeable reptiles.

Extensive coal and oil fields are among the natural resources of the Wind River Basin. Agriculture is largely supplemental to cattle and sheep raising. Under irrigation the arable valley lands and some of the lower bench lands are producing fine crops of alfalfa and other forage, and also cereals. The growing season is short for tomatoes and tender vegetables, but most kinds do well and are raised extensively near Lander, Fort Washakie, Riverton, and elsewhere. Apple growing has proved decidedly successful in certain protected valleys at the base of the mountains southwest of Lander, and small fruits are grown on a considerable scale at Lander and elsewhere. With an abundant supply of water in the Wind River Range, the reclamation and productiveness of considerable areas of both bench and valley lands await the construction of additional and especially higher irrigation canals.

BIGHORN BASIN—UPPER SONORAN ZONE.

The drainage basin of the Bighorn River is a large open area of 3,500 to 5,500 feet elevation lying between the high Bighorn and Absaroka Ranges in northwestern Wyoming; extending from the open Transition Zone ridge of the Owl Creek Mountains northward beyond the Montana line. It is a warm, protected section of low altitude and extreme aridity, but with an abundance of permanent streams, while the generally barren surface of its valley and low bench lands or scattered tracts of bad lands supports a scanty desert vegetation. The rainfall is often as light as 5 or 6 inches at Basin and Lovell, in the low central and northern sections, and less than 10 inches elsewhere. The Upper Sonoran Zone in this region covers an area of fairly regular outline about 100 miles in length from north to south by 60 miles in breadth, approximately 6,000 square miles. The zone is strongly characterized in the valleys and over the lower portions generally, reaching its upper limits at a little over 5,000 feet on the bordering sage slopes west and south, and eastward at anywhere from 5,500 to 6,000 feet on the abrupt hot slopes along the western bases of the Bighorn Mountains, where it includes an irregular belt of scattered junipers varying from 500 to 1,000 feet in vertical breadth.

The fauna and flora of the Bighorn Basin are derived alike from the Great Basin and Great Plains regions, and include few if any species not common to some of the other Sonoran areas of Wyoming. Over this region the Upper Sonoran Zone is variously characterized as to vegetation by a rank growth of broad-leaved cottonwood, willow, buffaloberry, skunk bush, and flowering currant along most of the streams; greasewood, rabbit brush, and *Suæda* on adobe river flats; saltbushes, rabbit brush, spiny sagebrush, prickly-pear cactus, and such plants as *Cleome lutea*, *Psoralea tenuiflora*, and *Plantago purshi* on firm-soil benches, with *Grayia spinosa*, *Polanisia trachysperma*, *Lupinus pusillus*, yucca, sand dock, and a small yellow-flowered *Malacothrix* added in sandy areas; and by a scattering growth of juniper and skunk bush on bad lands bluffs and on the rough southern and especially eastern margins of the basin. Extensive barren flats midway between Greybull and Cody have an almost pure growth of prickly-pear cactus, while similar tracts near Frannie are likewise clothed with the Nuttall saltbush.

Representative breeding birds include the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, bronzed grackle, western lark sparrow, sage sparrow, house finch, lazuli bunting, white-rumped shrike, yellow warbler, western yellow-throat, long-tailed chat, catbird, brown thrasher, and western marsh wren.

A few characteristic mammals of the Bighorn Basin are the pale chipmunk, black-tailed prairie-dog, Great Plains grasshopper mouse, Hayden field mouse, sage pocket gopher, kangaroo rat, Maximilian pocket mouse, Bailey cottontail, and the brown and California bats. Several reptiles, the prairie bull snake, plains rattlesnake, horned lizard, and scaly rock lizard, are common over much of the region.

This huge depression between lofty mountain ranges is a highly favored region of great promise. While physically and climatically the best suited to general agriculture of any of the low-altitude areas of western Wyoming, it is, perhaps, best known for its adaptation to horticulture and for the rapid strides already made in the successful production of high-grade apples and other fruits. The warm, sheltered valleys and hot Upper Sonoran slopes along the western bases of the Bighorn Mountains, especially toward the northern end of the basin, are highly favorable to fruit culture. It is in these situations that the older bearing orchards are chiefly located and the best results have thus far been obtained. Young orchards are now extensively planted throughout the lower open portions of the basin and, although more exposed than nearer the mountains, nevertheless give promise of handsome returns under proper care and due attention to local conditions.

The Bighorn River and its principal tributaries, the Shoshone and Greybull Rivers, and Shell, No Wood, and Owl Creeks, fed by the melting snows of high mountain ranges, carry an abundance of water, amply sufficient under proper storage control for watering all irrigable lands in their drainages (fig. 2). Private irrigation projects have already reclaimed considerable portions of the broad and fertile stream valleys, together with the lowest of the adjoining bench lands, and the Federal Shoshone project has opened large tracts in Shoshone Valley. The higher bench lands, at present utilized in sheep grazing, await the construction of more storage dams and higher irrigation canals before they can be made productive.

Characteristic Species—Upper Sonoran Zone.

The delimitation of life zones is based upon the combined ranges of characteristic species of mammals, breeding birds, reptiles, and

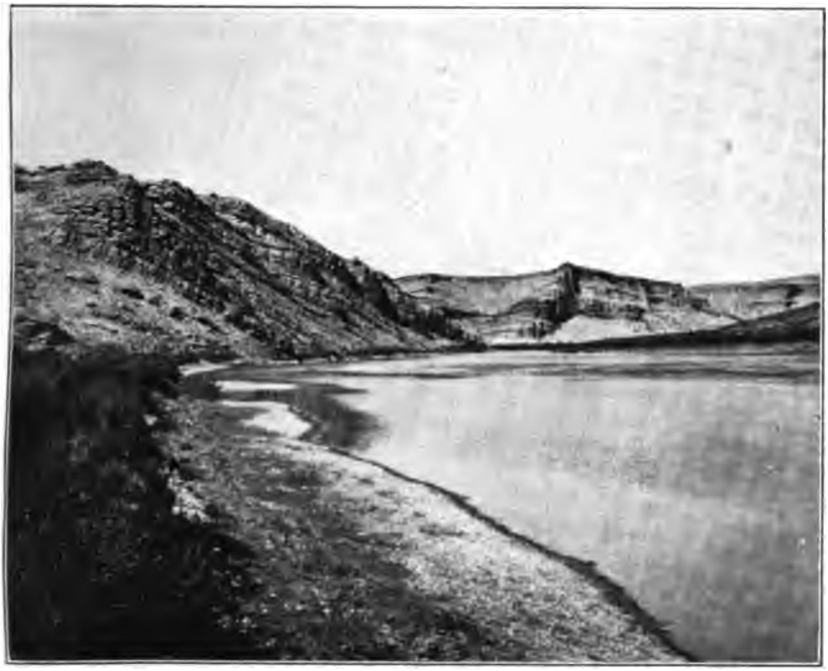

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FIG. 1.—BLUFFS ALONG GREEN RIVER NEAR UTAH BOUNDARY.

Dense growth of greasewood (*Sarcobatus vermiculatus*) at left.

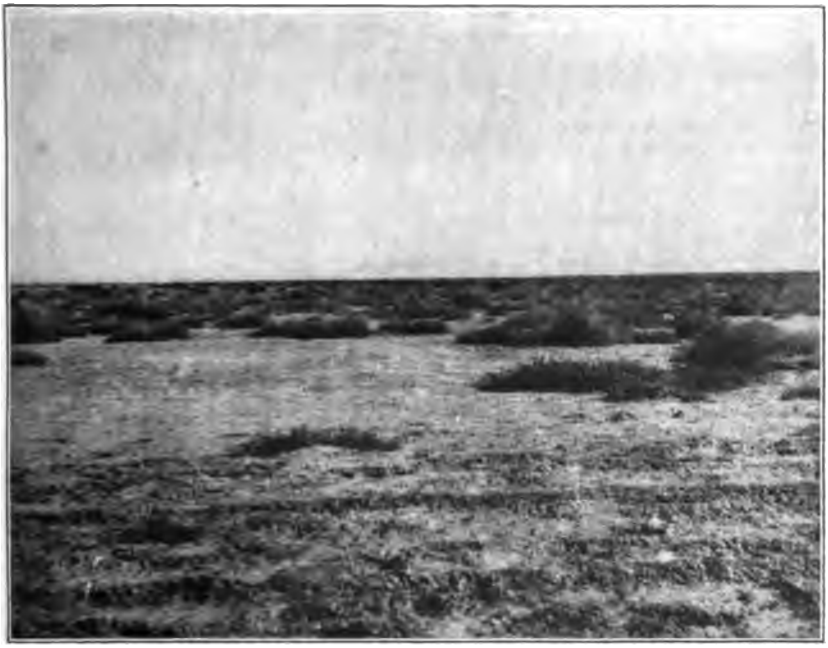

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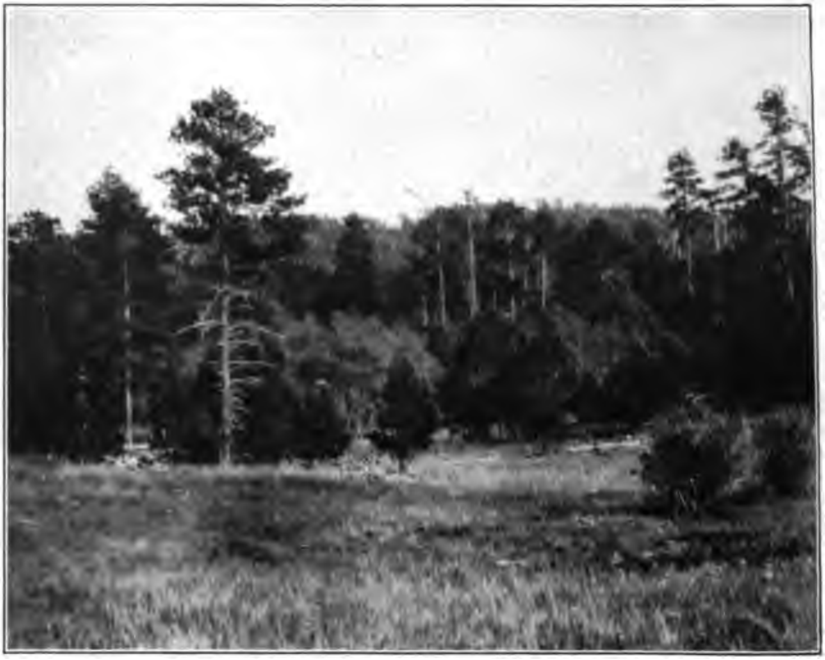
FIG. 2.—DESERT VEGETATION, RED DESERT, SOUTH OF THE FERRIS MOUNTAINS.

Chiefly saltbush (*Atriplex nuttalli*).



B11621

FIG. 1.—YELLOW PINE FOREST NEAR SPRINGHILL, NORTHERN BASE OF LARAMIE PEAK (6,500 FEET).

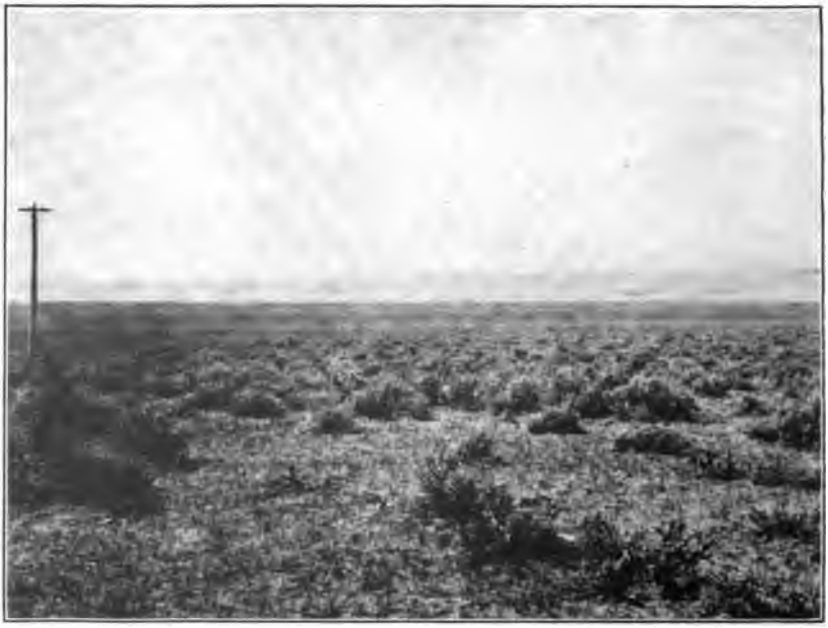


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FIG. 2.—SAGEBRUSH PLAIN NEAR FORT WASHAKIE, WIND RIVER BASIN.

plants.[1] Species which in Wyoming best mark the Upper Sonoran Zone throughout,[2] or in restricted areas of its Great Plains or Great Basin subdivisions, are included in the following lists. Many species of wide zonal dispersion occur commonly in the Upper Sonoran Zone in Wyoming, but as these give no definition to the zone they are not listed.

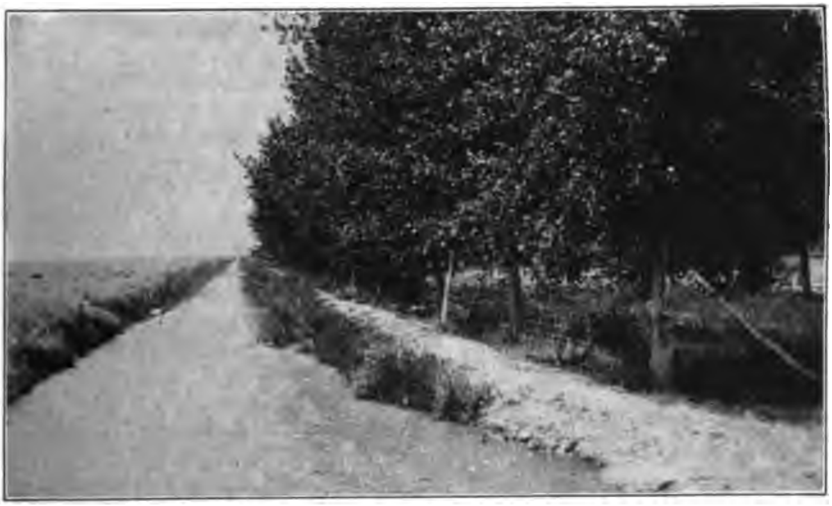

Fig. 2.—Irrigation canal traversing original sage plain on bench north of Burlington, in the Bighorn Basin.

MAMMALS—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Antilocapra americana americana, Antelope. *T.*

Eutamias pallidus pallidus, Pale Chipmunk. *T.*

Eutamias minimus minimus, Least Chipmunk.

Eutamias minimus pictus, Sagebrush Chipmunk.

Eutamias dorsalis utahensis, Utah Rock Chipmunk.

Callospermophilus lateralis wortmani, Wortman Mantled Ground Squirrel. *T.*

Citellus obsoletus, Kennicott Ground Squirrel.

Citellus tridecemlineatus pallidus, Pale Striped Ground Squirrel.

Citellus tridecemlineatus parvus, Small Striped Ground Squirrel.

Cynomys ludovicianus ludovicianus, Black-tailed Prairie-dog.

Onychomys leucogaster arcticeps, Great Plains Grasshopper Mouse.

Peromyscus maniculatus osgoodi, Black-eared White-footed Mouse. *T.*

Peromyscus maniculatus nebrascensis, Yellow White-footed Mouse.

Peromyscus crinitus auripectus, Golden-breasted Canyon Mouse.

Peromyscus truei truei, True's Cliff Mouse.

Reithrodontomys megalotis dychei, Prairie Harvest Mouse.

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[1] Species of insects and other groups might be equally useful in the determination of zones if their ranges were better known.

[2] See frontispiece (map).

MAMMALS—UPPER SONORAN ZONE—Continued.

Neotoma cinerca orolestes, Colorado Bushy-tailed Wood Rat. *T.*

Microtus ochrogaster haydeni, Hayden Field Mouse.

Fiber zibethicus cinnamominus, Great Plains Muskrat. *T.*

Geomys lutescens, Yellow Pocket Gopher.

Thomomys ocius, Green River Pocket Gopher.

Thomomys talpoides bullatus, Sage Pocket Gopher.

Perodipus ordii luteolus, Wyoming Kangaroo Rat.

Perognathus hispidus paradoxus, Kansas Pocket Mouse.

Perognathus fasciatus fasciatus, Maximilian Pocket Mouse. *T.*

Perognathus fasciatus litus, Sweetwater Pocket Mouse.

Perognathus flavus piperi, Cheyenne Pocket Mouse.

Perognathus callistus, Red Desert Pocket Mouse.

Lepus californicus melanotis, Black-tailed Jack Rabbit.

Sylvilagus auduboni baileyi, Bailey Cottontail.

Sylvilagus floridanus similis, Nebraska Cottontail.

Canis nebracensis, Plains Coyote. *T.*

Vulpes velox velox, Kit Fox, Swift. *T.*

Procyon lotor lotor, Raccoon. *T.*

Taxidea taxus taxus, Badger. *T.*

Spilogale gracilis saxatilis, Great Basin Spotted Skunk.

Mustela nigripes, Black-footed Ferret.

Scalopus aquaticus caryi, Northern Plains Mole.

Myotis californicus californicus, California Bat.

Myotis evotis, Long-eared Bat.

Myotis longicrus interior, Long-legged Bat. *T.*

Eptesicus fuscus fuscus, Brown Bat. *T.*

BREEDING BIRDS—UPPER SONORAN ZONE.

[Species marked *T.* breed also in the Transition Zone.]

Querquedula discors, Blue-winged Teal. *T.*

Querquedula cyanoptera, Cinnamon Teal. *T.*

Botaurus lentiginosus, Bittern. *T.*

Ardea herodias, Great Blue Heron. *T.*

Nycticorax nycticorax nævius, Black-crowned Night Heron. *T.*

Rallus virginianus, Virginia Rail.[1]

Porzana carolina, Carolina Rail, Sora. *T.*

Fulica americana, Coot. *T.*

Bartramia longicauda, Upland Plover. *T.*

Numenius americanus, Long-billed Curlew. *T.*

Zenaidura macroura carolinensis, Mourning Dove.

Archibuteo ferrugineus, Ferruginous Rough-legged Hawk. *T.*

Speotyto cunicularia hypugæa, Burrowing Owl.

Chordeiles virginianus henryi, Western Nighthawk. *T.*

Tyrannus tyrannus, Kingbird. *T.*

Tyrannus verticalis, Arkansas Kingbird.

Tyrannus vociferans, Cassin Kingbird.

Corvus brachyrhynchos hesperis, Western Crow. *T.*

Cyanocephalus cyanocephalus, Pinyon Jay.

Xanthocephalus xanthocephalus, Yellow-headed Blackbird. *T.*

Agelaius phœniceus fortis, Thick-billed Redwing. *T.*

Sturnella neglecta, Western Meadowlark. *T.*

Icterus bullocki, Bullock Oriole.

Quiscalus quiscula æneus, Bronzed Grackle.

Carpodacus mexicanus frontalis, House Finch.

Ammodramus savannarum bimaculatus, Western Grasshopper Sparrow.

Chondestes grammacus strigatus, Western Lark Sparrow.

Spizella breweri, Brewer Sparrow. *T.*

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[1] Observed during breeding season.

BREEDING BIRDS—UPPER SONORAN ZONE—Continued.

Amphispiza nevadensis, Sage Sparrow.
Passerina amœna, Lazuli Bunting.
Spiza americana, Dickcissel.
Calamospiza melanocorys, Lark Bunting. *T.*
Lanius ludovicianus excubitorides, White-rumped Shrike. *T.*
Dendroica æstiva æstiva, Yellow Warbler. *T.*
Geothlypis trichas occidentalis, Western Yellow-throat. *T.*
Icteria virens longicauda, Long-tailed Chat.
Oreoscoptes montanus, Sage Thrasher. *T.*
Mimus polyglottos leucopterus, Western Mockingbird.
Dumetella carolinensis, Catbird.
Toxostoma rufum, Brown Thrasher.
Thryomanes bewicki bairdi, Baird Wren.[1]
Telmatodytes palustris plesius, Western Marsh Wren.
Bœolophus inornatus griseus, Gray Titmouse.[1]
Psaltriparus plumbeus, Lead-colored Bush-tit.[1]
Polioptila cærulea obscura, Western Gnatcatcher.[1]

REPTILES—UPPER SONORAN ZONE.

[Species marked *T*. occur also in the Transition Zone.]

Lizards.

Holbrookia maculata, Sand Swift.
Uta stansburiana, Stansbury Lizard.
Sceloporus consobrinus, Scaly Lizard.
Sceloporus graciosus, Scaly Rock Lizard.
Phrynosoma ornatissimum, Desert Short-horned Lizard. *T.*
Cnemidophorus sexlineatus, Six-lined Lizard.
Eumeces multivirgatus, Many-lined Skink.

Snakes.

Thamnophis sirtalis parietalis, Red-barred Garter Snake. *T.*
Thamnophis radix, Garter Snake. *T.*
Bascanion constrictor, Blue Racer.
Pituophis sayi, Prairie Bull Snake.
Liopeltis vernalis, Smooth Green Snake. *T.*
Heterodon nasicus, Hog-nosed Snake.
Crotalus confluentus, Plains Rattlesnake.

AMPHIBIANS—UPPER SONORAN ZONE.

[Species marked *T*. occur also in the Transition Zone.]

Toads and frogs.

Scaphiopus hammondi bombifrons, Spadefoot Toad.
Bufo lentiginosus woodhousei, Toad. *T.*
Bufo cognatus, Toad.
Rana pipiens, Leopard Frog. *T.*

Salamanders.

Ambystoma tigrinum, Tiger Salamander. *T.*

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[1] Probably breeds.

PLANTS—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Trees and shrubs.

Pinus edulis, Pinyon, Nut Pine.
Juniperus knighti, Desert Juniper.
Juniperus monosperma, One-seeded Juniper.
Populus occidentalis, Broad-leaved Cottonwood.
Populus acuminata, Lance-leaved Cottonwood.
Salix amygdaloides, Peach-leaved Willow.
Salix fluviatilis, Sand-bar Willow.
Ulmus americana,[1] Elm. *T.*
Acer negundo, Box Elder. *T.*
Fraxinus lanceolata, Ash. *T.*
Cercocarpus parvifolius, Mountain Mahogany. *T.*
Sarcobatus vermiculatus, Greasewood.
Atriplex canescens, Saltbush, Gray Shadscale.
Atriplex confertifolia, Spiny Saltbush.
Atriplex nuttalli, Nuttall Saltbush.
Atriplex pabularis, Nelson Saltbush.
Atriplex argentea, Silvery Saltbush.
Eurotia lanata, White Sage, Winter Fat.
Grayia spinosa, Grayia.
Kochia americana, Kochia, White Sage.
Philadelphus occidentalis, Western Syringa.
Ribes longiflorum, Flowering Currant.
Prunus americana, Wild Plum. *T.*
Prunus besseyi, Sand Cherry.
Amorpha canescens, False Indigo, Shoestring. *T.*
Amorpha nana, False Indigo.
Schmaltzia trilobata, Skunk Bush.
Schmaltzia glabra, Smooth Sumac. *T.*
Rhus rydbergi, Western Poison Ivy. *T.*
Vitis vulpina, Wild Grape. *T.*
Parthenocissus vitacea, Virginia Creeper. *T.*
Lepargyrea argentea, Buffaloberry. *T.*
Symphoricarpos occidentalis, Wolfberry. *T.*
Gutierrezia sarothræ, Rabbit Brush.
Chrysothamnus graveolens, Rabbit Brush.
Chrysothamnus plattensis, Rabbit Brush.
Chrysothamnus linifolius, Rabbit Brush.
Chrysothamnus stenophyllus, Rabbit Brush.
Tetradymia inermis, Rabbit Brush.
Tetradymia spinosa, Rabbit Brush.
Tetradymia nuttalli, Rabbit Brush.
Artemisia filifolia, Narrow-leaved Sagebrush.
Artemisia spinescens, Spiny Sagebrush, Budbrush.
Artemisia pedatifida, Small Brown Sagebrush.
Artemisia tridentata, Black Sagebrush. *T.*

Herbaceous plants.

Tradescantia occidentalis, Spiderwort.
Yucca glauca, Plains Yucca.
Eriogonum effusum, Eriogonum.
Eriogonum annuum, Eriogonum.
Eriogonum campanulatum, Eriogonum.
Eriogonum corymbosum, Eriogonum.
Eriogonum multiceps, Eriogonum.
Rumex venosus, Sand Dock.
Suæda diffusa, Sea Blite.
Suæda moquini, Shrubby Blite.
Endolepsis suckleyana.
Salicornia rubra, Glasswort. *T.*
Abronia fragrans.
Abronia elliptica.
Argemone intermedia, Prickly Poppy.
Argemone hispida, Prickly Poppy.
Stanleya tomentosa, Stanleya.
Stanleya integrifolia, Stanleya.
Cleome lutea, Yellow Cleome.
Cleome serrulata, Red Cleome, Honey Plant.
Polanisia trachysperma, Clammy-weed.
Lupinus plattensis, Lupine.
Lupinus pusillus, Small Lupine.

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[1] Northeast Wyoming only.

Plants—Upper Sonoran Zone—Continued.

Herbaceous plants—Continued.

Astragalus crassicarpus, Buffalo Bean, Ground Plum.
Astragalus mollissimus, Milk Vetch.
Astragalus missouriensis, Milk Vetch.
Glycyrrhiza lepidota, Wild Licorice. *T.*
Psoralea tenuiflora, Psoralea.
Psoralea linearifolia, Narrow-leaved Psoralea.
Psoralea lanceolata, Psoralea.
Psoralea hypogea, Psoralea.
Psoralea esculenta, Psoralea.
Parosela enneandra, Dalea.
Petalostemon oligophyllus, White Prairie Clover.
Petalostemon candidus, Prairie Clover.
Petalostemon purpureus, Purple Prairie Clover.
Petalostemon villosus, Silky Prairie Clover.
Lathyrus ornatus, Wild Pea, Vetchling.
Linum rigidum, Wild Flax.
Euphorbia marginata, Snow-on-the-mountain.
Croton texensis, Croton.
Malvastrum coccineum, False Mallow.
Malvastrum dissectum, False Mallow.
Mentzelia decapetala, Loasa.
Mentzelia nuda, Loasa.
Mentzelia albicaulis, Loasa.
Mentzelia lævicaulis. Yellow Loasa. *T.*
Mamillaria missouriensis, Ball Cactus. *T.*
Mamillaria vivipara, Ball Cactus.
Echinocereus viridiflorus, Green-flowered Petaya. *T.*
Opuntia polyacantha, Prickly Pear.
Opuntia rutila, Prickly Pear.
Anogra albicaulis, White Evening Primrose.
Galpinsia lavandulæfolia.
Meriolix serrulata.
Gaura coccinea.
Asclepias speciosa, Milkweed.
Asclepias pumila, Milkweed.
Ipomœa leptophylla, Bush Morning-glory.
Gilia polycladon.
Lithospermum angustifolium, Gromwell. *T.*
Lithospermum gmelini, Gromwell.
Oreocarya flava.
Lippia cuneifolia.
Verbena hastata, Blue Vervain.
Verbena bracteosa, Low Vervain.
Physalis lanceolata, Ground Cherry.
Solanum rostratum, Buffalo Bur.
Pentstemon albidus, Beard-tongue.
Pentstemon angustifolius, Beard-tongue.
Plantago purshi, Plantain.
Liatris punctata, Blazing Star.
Grindelia squarrosa, Gum Plant.
Sideranthus spinulosus.
Solidago mollis, Goldenrod.
Solidago canadensis gilvocanescens, Goldenrod.
Solidago rigida, Goldenrod.
Ratibida columnaris, Cone Flower.
Helianthus annuus, Sunflower.
Helianthus petiolaris, Sunflower.
Hymenopappus filifolius.
Carduus plattensis, Thistle.
Malacothrix sonchoides.
Lygodesmia juncea.
Lygodesmia rostrata.

Grasses.

Andropogon scoparius, Bluestem.
Andropogon halli, Bluestem.
Panicum virgatum, Panic Grass.
Aristida longiseta, Wire Grass. *T.*
Stipa comata, Feather Grass.
Stipa viridula, Feather Grass. *T.*
Oryzopsis micrantha, Rice Grass.
Eriocoma cuspidata, Indian Millet.
Muhlenbergia pungens, Dropseed Grass.
Sporobolus airoides, Fine-top Salt Grass.
Sporobolus cryptandrus, Bunch Grass.
Calamovilfa longifolia, Reed Grass, Sand Grass.
Schedonnardus paniculatus, Crab Grass.

PLANTS—UPPER SONORAN ZONE—Continued.

Grasses—Continued.

Spartina gracilis, Marsh Grass.
Bouteloua oligostachya, Grama Grass. *T.*
Bouteloua hirsuta, Grama Grass.
Atheropogon curtipendula, Tall Grama. *T.*
Bulbilis dactyloides, Buffalo Grass.
Munroa squarrosa, False Buffalo Grass.
Eatonia obtusata.
Distichlis spicata, Salt Grass.
Poa fendleriana, Spear Grass. *T.*
Poa sheldoni, Spear Grass. *T.*
Festuca octoflora, Fescue Grass.
Agropyron spicatum, Wheat Grass.
Agropyron smithi, Wheat Grass. *T.*
Sitanion longifolium, Long-bearded Rye Grass. *T.*
Sitanion hystrix. *T.*
Elymus canadensis, Wild Rye. *T.*
Elymus condensatus, Giant Rye Grass. *T.*
Elymus salinus, Desert Rye Grass.

Agricultural Utility of the Upper Sonoran Zone.

The growing of hay and forage crops as supplemental to stock raising and a limited planting of cereals and vegetables for ranch use long constituted the chief agricultural endeavors in even the most favored sections of Wyoming. The establishment of agriculture as a separate industry in this arid region is comparatively recent, the result of greatly increased irrigation facilities and of more efficient methods of conserving the rainfall in the less arid dry-farming districts.

The Upper Sonoran areas of Wyoming lie mainly in the upper and cooler parts of the zone and are therefore climatically unsuited to a variety of tender crops, and especially fruits, which are successfully grown elsewhere in its lower and warmer portions. They are proving well adapted, however, to most of the standard varieties of wheat, oats, rye, emmer, and other cereals, which yield abundantly under irrigation and moderately under dry farming. None but the early varieties of corn mature, and these are raised to a small extent only in the warmest parts, as in the lower Platte and Bighorn Valleys. Alfalfa, the staple forage crop, produces regularly two and at the lowest elevations often three or even four crops a year. Sugar beets are raised extensively in the Bighorn Basin, the lower Platte Valley, and near Wheatland. The sugar content of Wyoming beets is high, and with the construction of local sugar factories this crop should become one of the most important and profitable. Potatoes yield abundantly and are well adapted to the dry-farming districts along the eastern edge of the State, where they are produced on a large scale. Vegetables of most sorts thrive under irrigation, and trucking is profitably carried on in many valleys. The tender sorts usually succeed in the warmest localities, but can not be raised generally, because of the short growing season.

Fruit growing has been attempted on a commercial scale mainly in the Bighorn Basin, near Lander, and in the Wheatland district, where many of the hardier varieties of apples, cherries, and plums, as well as the small fruits, raspberries, strawberries, grapes, currants, gooseberries, and dewberries, are moderately successful under irrigation. Even in these sheltered and favored districts the physical and climatic conditions are so localized that successful horticulture will perforce be limited to comparatively small areas where there is ample protection and the greatest freedom from the destructive late frosts, which kill so much of the fruit blossom in this zone throughout the Rocky Mountain region. Late-flowering and frost-resistant varieties succeed best.

TRANSITION ZONE.

Fully half of Wyoming, or about 50,000 square miles, is in the Transition Zone, the zone intermediate between the Boreal and Austral regions, which is here in its greater part open and treeless, and thus less conspicuously characterized than in the southern Rocky Mountain region, where it is very generally marked by extensive forests of yellow pine. In Wyoming the zone comprises, broadly, vast interior sagebrush plains (see Pl. V, fig. 2) and watersheds, plateaus, and high-altitude basins in the central and southwest sections; and elevated grassy plains to the east and southeast. It also includes all except the higher summits of the pine-clad foothill ranges in the eastern part of the State, and the open basal sagebrush slopes of the high mountain ranges farther west. In greater detail,[1] the Transition Zone in Wyoming embraces the following important areas:

The Cheyenne Plains above 5,500 feet elevation; Lusk Plains above 5,000 feet; all of the Laramie Plains and Shirley Basin; upper valley of the North Platte above 6,500 feet; upper Green River Basin, Bear River region, and extensive tracts on the borders of the Red Desert above 6,500 feet; sage plains between Casper and Lander above 6,000 feet; Wind River Valley above 6,000 feet; mainly open borders of the Bighorn Basin, 5,500 to 7,000 or 7,500 feet; all open or partly timbered watersheds between the Bighorn and Bear Lodge Mountains above 4,500 feet; basal and middle slopes of Bear Lodge Mountains and northern Black Hills, 4,000 to 5,500 feet; and southern Black Hills region, 4,500 to 6,000 feet. Limited areas in Jackson Hole and Salt River Valley are eastward continuations of the Snake River Transition Zone, and narrow strips of the zone enter Yellowstone Park for a short distance along the Yellowstone, penetrating the valleys of the Gardiner, Lamar, and other tributaries, and also along the Gallatin, Madison, and Fall River valleys.

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[1] See zone map (frontispiece).

The foregoing well illustrates the effect of both base level and latitude on the vertical position of the Transition Zone. A base level of over 6,000 feet in the southwest elevates the zone in all of the region contiguous to the Red Desert and Green River Valley to between 7,000 and 8,500 feet on warmest (southwest) slopes and 6,000 to 7,500 feet on coldest (northeast) slopes. In extreme northeastern Wyoming, adjacent to the low-altitude northern Great Plains, the zone level attains only 4,500 to 6,000 feet on southwest slopes and 4,000 to 5,500 feet on northeast slopes.[1] Much of this 2,000-foot variation in zone level results from difference in base elevation, while probably 800 feet is normal depression in the northeast due to higher latitude. Locally, mountain slopes of unusual exposure and warmth carry zones abnormally high, and if very steep and abrupt the horizontal contraction is also very marked. This is well shown in the Transition belt on the abrupt, hot, southwest slopes of the Bighorn Mountains east of Greybull and Ionia. Varied physical conditions, and, to a certain extent, deforestation, affect both the elevation and the horizontal as well as the vertical width of life zones, especially in mountainous districts. In the main, however, the Transition Zone is maintained in fairly uniform elevation and width along the bases of the Wyoming ranges.

Characteristic Species—Transition Zone.

The Transition Zone in Wyoming is conspicuously marked only along its upper border, where mostly open sage slopes give way to the aspen and coniferous forest belt of the Canadian Zone. Inconspicuous vegetation is characteristic of the lower part on the open plains, where the zonal position is further indicated by either the absence or a marked paucity of Sonoran species. As elsewhere in the Rocky Mountain region, its fauna and flora are fairly constant throughout, but include many species, both Boreal and Austral, from the adjoining zones.

Sagebrush, yellow pine, and grasses are prominent types of vegetation in the Wyoming Transition area. The sagebrush (Pl. VI), the most widely distributed shrub, usually occurs in pure growth, while the yellow pines are restricted largely to the lower mountains, foothills, and rough tracts in the eastern half of the State. Considerable Douglas spruce and scattering Rocky Mountain white pines

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[1] On exposed slopes of mountains the difference in zone level on the warm and cold sides is usually as much as 1,000 feet. So much variation is not found in the low hill country of northeastern Wyoming.

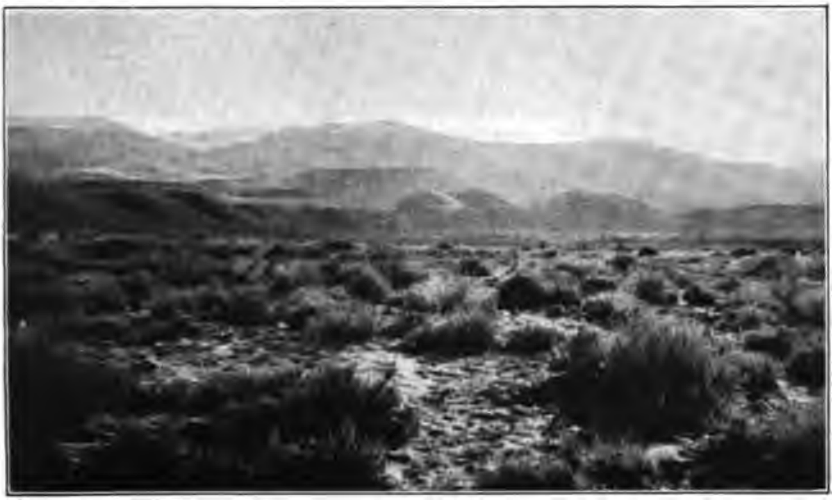

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FIG. 1.—SAGEBRUSH IN WIND RIVER VALLEY.

Lower part of Transition Zone, near Circle.

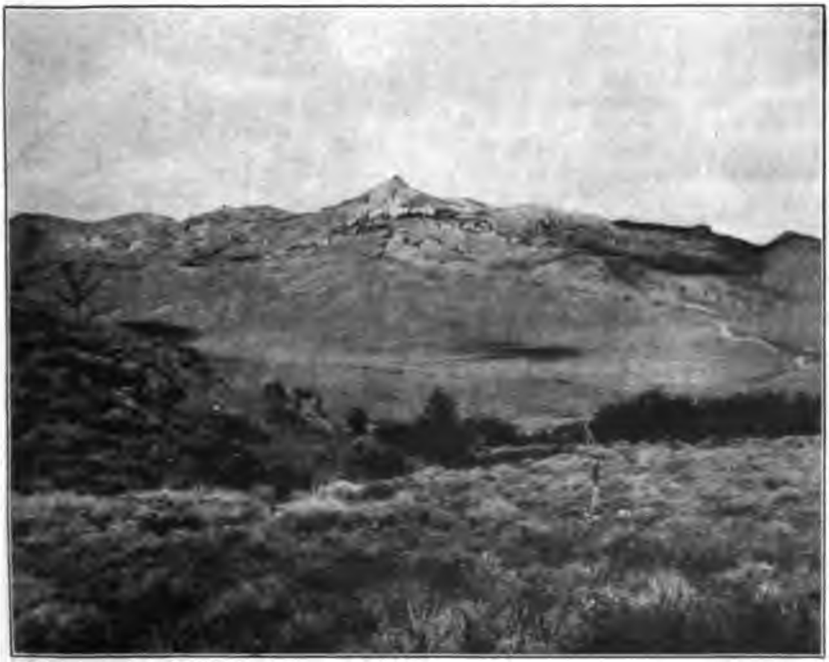

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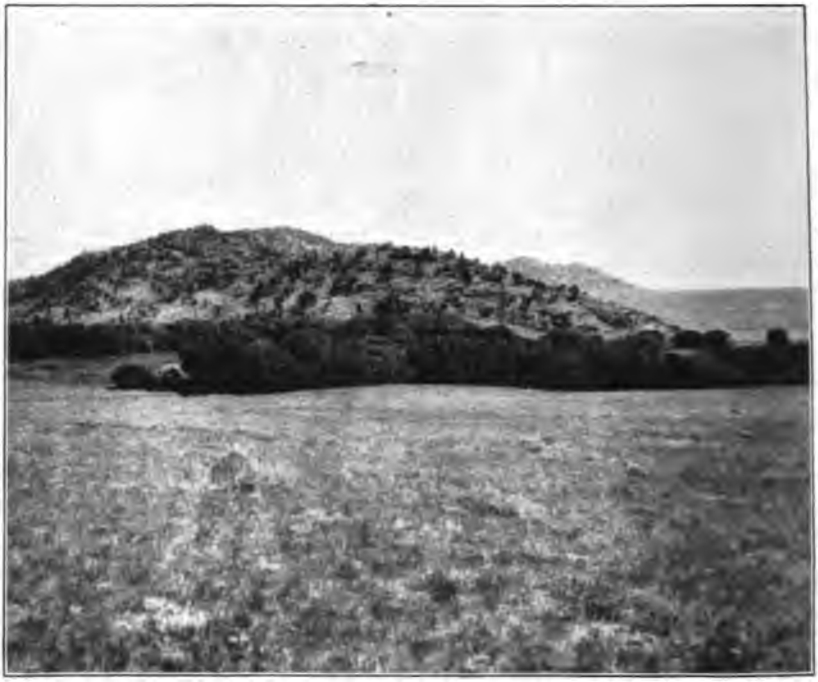
FIG. 2.—GARFIELD PEAK, RATTLESNAKE MOUNTAINS.

Sagebrush covers much of this barren 8,000 to 9,000 foot range.



B11619

FIG. 1.—RAWHIDE BUTTE, LOWER BORDER OF TRANSITION ZONE, AT EDGE OF GREAT PLAINS.

Narrow-leaved cottonwoods on Rawhide Creek, southern base of the butte, and yellow pines on hills (5,000 feet).

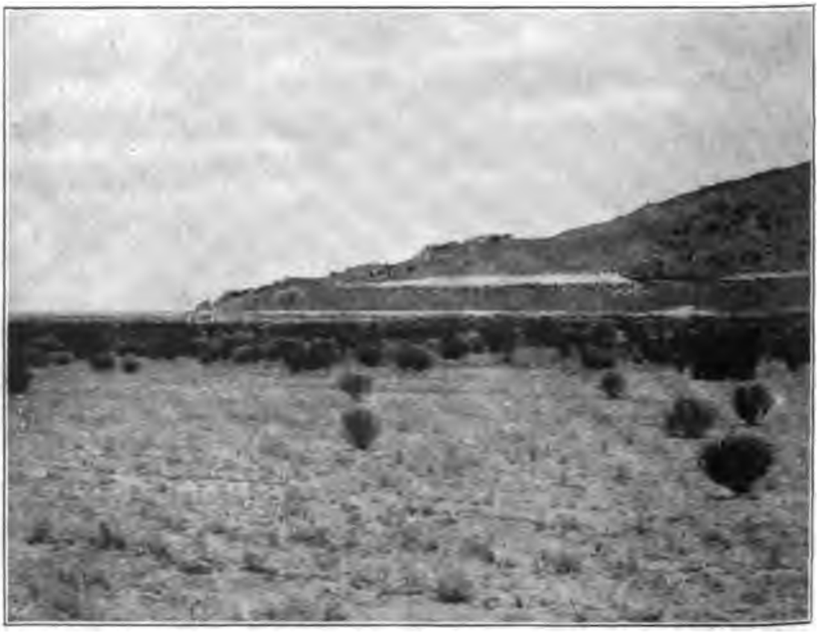


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FIG. 2.—SOUTHWESTERN BASE OF WIND RIVER RANGE NEAR BIG SANDY.

Rabbit brush (*Chrysothamnus* and *Tetradymia inermis*) on the plain (7,500 feet).

occur in this zone in the mountains of western Wyoming, and the bur oak is a common tree on the Bear Lodge Mountains and elsewhere in northern Crook County. On streams along the bases of the mountains generally the zone is marked by narrow-leaved cottonwood (Pl. VII, fig. 1), diamond willow, and usually by a dense shrubbery of Rocky Mountain birch, black and red haws, cornel, wild gooseberry and currant, serviceberry, and silverberry; on foothill and lower mountain slopes both in the forest as undershrubs and in the open, by Rocky Mountain and creeping junipers, Bebb willow, barberry, wild red currant, mountain mahogany, kunzia, ninebark, wild cherry, mountain and large-toothed maples, mountain balm, bearberry, mountain snowberry, and several high plains species of sagebrush and rabbit brush (Pl. VII, fig. 2); and throughout by a great many herbaceous plants.

A considerable number of birds of both general and restricted breeding range within the zone characterize this area in Wyoming during the nesting season. Representative species are the sage hen, sharp-shinned hawk, saw-whet owl, Lewis woodpecker, white-throated swift, Wright flycatcher, magpie, pinyon jay, McCown longspur, white-winged junco, mountain song sparrow, arctic and green-tailed towhees, western tanager, plumbeous vireo, Macgillivray warbler, Rocky Mountain and pygmy nuthatches, and willow thrush.

Mammals wholly or chiefly restricted to the Transition Zone in different parts of Wyoming include the plains white-tailed deer; Black Hills red squirrel; Wyoming and Uinta ground squirrels; white-tailed prairie-dog; bushy-tailed wood rat; pygmy and Uinta field mice; Coues, Black Hills, Fort Bridger, and pygmy pocket gophers; Uinta pocket mouse; prairie jumping mouse; white-tailed jack rabbit; Black Hills cottontail; northern plains skunk; and long-legged bat.

The following reptiles and amphibians are apparently more abundant in the Transition than in the Upper Sonoran Zone in Wyoming: Western garter snake (*Thamnophis ordinoides vagrans*), a toad (*Bufo boreas*), and a frog (*Rana pretiosus*). Others of regular occurrence in at least the lower part of the zone include the horned lizard (*Phrynosoma ornatissimum*), scaly rock lizard (*Sceloporus graciosus*), garter snakes (*Thamnophis sirtalis parietalis* and *T. radix*), smooth green snake (*Liopeltis vernalis*), western toad (*Bufo lentiginosus woodhousei*), frogs (*Rana pipiens* and *Chorophilus triseriatus*), and tiger salamander (*Ambystoma tigrinum*).

MAMMALS—TRANSITION ZONE.

[Species marked *U.* occur also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Cervus canadensis canadensis, Elk. *C.*
Odocoileus virginianus macrourus, Plains White-tailed Deer.
Odocoileus hemionus hemionus, Mule Deer. *U.*, *C.*
Ovis canadensis auduboni, Bad Lands Sheep.[1] *U.*
Sciurus hudsonicus dakotensis, Black Hills Red Squirrel.
Glaucomys sabrinus canescens, Flying Squirrel.
Callospermophilus lateralis lateralis, Say Ground Squirrel. *C.*
Callospermophilus lateralis wortmani, Wortman Ground Squirrel. *U.*
Citellus richardsoni elegans, Wyoming Ground Squirrel. *U.*
Citellus armatus, Uinta Ground Squirrel. *C.*
Cynomys leucurus, White-tailed Prairie-dog. *U.*
Onychomys leucogaster brevicaudus, Idaho Grasshopper Mouse. *U.*
Onychomys leucogaster missouriensis, Northern Grasshopper Mouse. *U.*
Peromyscus leucopus aridulus, White-footed Mouse.
Neotoma cinerea cinerea, Bushy-tailed Wood Rat.
Neotoma cinerea orolestes, Colorado Bushy-tailed Wood Rat. *U.*
Microtus pennsylvanicus modestus, Saguache Meadow Mouse. *U.*
Microtus montanus caryi, Uinta Meadow Mouse.
Microtus pauperrimus, Pygmy Field Mouse.
Fiber zibethicus osoyoosensis, Rocky Mountain Muskrat. *C.*
Castor canadensis, Beaver. *C.*
Thomomys talpoides nebulosus, Black Hills Pocket Gopher. *C.*
Thomomys talpoides clusius, Coues Pocket Gopher.
Thomomys bridgeri, Fort Bridger Pocket Gopher.
Thomomys pygmæus, Pygmy Pocket Gopher.
Perognathus parvus clarus, Uinta Pocket Mouse.
Zapus hudsonius campestris, Prairie Jumping Mouse.
Erethizon epixanthum, Yellow-haired Porcupine. *C.*
Lepus townsendi campanius, White-tailed Jack Rabbit.
Lepus townsendi townsendi, Western White-tailed Jack Rabbit.
Sylvilagus nuttalli grangeri, Black Hills Cottontail.
Felis hippolestes, Mountain Lion. *C.*
Lynx uinta, Mountain Wildcat.
Canis nubilus, Buffalo Wolf. *U.*
Canis lestes, Mountain Coyote.
Taxidea taxus taxus, Badger. *U.*
Spilogale tenuis, Rocky Mountain Spotted Skunk.
Mephitis hudsonica, Northern Plains Skunk.
Mustela arizonensis, Arizona Weasel. *C.*
Mustela vison energumenos, Mink. *C.*
Ursus horribilis, Grizzly Bear.
Corynorhinus macrotis pallescens, Big-eared Bat. *U.*
Myotis longicrus interior, Long-legged Bat. *U.*

BREEDING BIRDS—TRANSITION ZONE.

[Species marked *U.* breed also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Colymbus nigricollis californicus, American Eared Grebe. *U.*
Anas platyrynchos, Mallard. *U.*
Chaulelasmus streperus, Gadwall. *U.*
Nettion carolinense, Green-winged Teal.
Steganopus tricolor, Wilson Phalarope. *U.*
Recurvirostra americana, Avocet. *U.*
Gallinago delicata, Wilson Snipe. *C.*
Catoptrophorus semipalmatus inornatus, Western Willet.

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[1] Apparently nearing extinction.

BREEDING BIRDS—TRANSITION ZONE—Continued.

Podasocys montanus, Mountain Plover. *U.*

Pediœcetes phasianellus columbianus, Columbian Sharp-tailed Grouse.

Centrocercus urophasianus, Sage Hen.

Accipiter velox, Sharp-shinned Hawk. *C.*

Accipiter cooperi, Cooper Hawk.

Buteo swainsoni, Swainson Hawk.

Cryptoglaux acadica, Saw-whet Owl.

Otus asio maxwelliæ, Rocky Mountain Screech Owl. *U.*

Asio wilsonianus, Long-eared Owl.

Coccyzus erythropthalmus, Black-billed Cuckoo. *U.*[1]

Dryobates villosus monticola, Rocky Mountain Hairy Woodpecker. *C.*

Dryobates pubescens homorus, Batchelder Woodpecker.

Melanerpes erythrocephalus, Red-headed Woodpecker. *U.*

Asyndesmus lewisi, Lewis Woodpecker.

Phalænoptilus nuttalli nuttalli, Poorwill. *U.*

Aëronautes melanoleucus, White-throated Swift. *U.*

Stellula calliope, Calliope Hummingbird.[2]

Sayornis sayus, Say Phœbe. *U.*

Myiochanes richardsoni, Western Wood Pewee.

Empidonax minimus, Least Flycatcher.

Empidonax wrighti, Wright Flycatcher.

Empidonax hammondi, Hammond Flycatcher. *C.*

Otocoris alpestris leucolæma, Desert Horned Lark. *U.*

Pica pica hudsonia, Magpie.

Cyanocephalus cyanocephalus, Pinyon Jay. *U.*

Dolichonyx oryzivorus, Bobolink. *U.*

Euphagus cyanocephalus, Brewer Blackbird. *U.*

Calcarius ornatus, Chestnut-collared Longspur. *U.*

Rhynchophanes mccowni, McCown Longspur.

Poœcetes gramineus confinis, Western Vesper Sparrow. *U.*

Passerculus sandwichensis alaudinus, Western Savannah Sparrow. *U.*

Spizella passerina arizonæ, Western Chipping Sparrow.

Spizella breweri, Brewer Sparrow. *U.*

Junco aikeni, White-winged Junco.

Melospiza melodia montana, Mountain Song Sparrow.

Passerella iliaca schistacea, Slate-colored Fox Sparrow.

Pipilo maculatus arcticus, Arctic Towhee.

Oreospiza chlorura, Green-tailed Towhee.

Zamelodia melanocephala, Black-headed Grosbeak. *U.*

Piranga ludoviciana, Western Tanager.

Tachycineta thalassina lepida, Northern Violet-green Swallow. *C.*

Vireosylva gilva swainsoni, Western Warbling Vireo.

Lanivireo solitarius plumbeus, Plumbeous Vireo.

Dendroica auduboni, Audubon Warbler. *C.*

Dendroica nigrescens, Black-throated Gray Warbler.[3]

Seiurus aurocapillus, Oven-bird. *C.*

Oporornis tolmiei, Macgillivray Warbler. *C.*

Oreoscoptes montanus, Sage Thrasher. *U.*

Salpinctes obsoletus, Rock Wren. *U.*

Troglodytes aëdon parkmani, Western House Wren. *U.*

Sitta carolinensis nelsoni, Rocky Mountain Nuthatch.

Sitta pygmæa, Pygmy Nuthatch.

Penthestes atricapillus septentrionalis, Long-tailed Chickadee. *U.*

Hylocichla fuscescens salicicola, Willow Thrush.

Planesticus migratorius propinquus, Western Robin. *C.*

Sialia currucoides, Mountain Bluebird. *C.*

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[1] Observed during breeding season.

[2] Taken during breeding season.

[3] Probably breeds.

Plants—Transition Zone.

[Species marked *U.* occur also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Trees and shrubs.

Pinus scopulorum, Yellow Pine, Rock Pine.
Juniperus scopulorum, Rocky Mountain Juniper. *U.*
Juniperus sabina, Creeping Juniper, Trailing Savin.
Populus angustifolia, Narrow-leaved Cottonwood.
Salix bebbiana, Bebb Willow. *C.*
Salix cordata watsoni, Diamond Willow. *U.*
Salix mackenziana, Diamond Willow.
Salix scouleriana, Willow.
Betula fontinalis, Rocky Mountain Birch.
Quercus macrocarpa, Bur Oak.
Berberis aquifolium, Barberry, Oregon Grape.
Grossularia inermis, Gooseberry.
Ribes inebrians, Red Currant.
Ribes americanum, Currant.
Edwinia americana.
Cercocarpus ledifolius, Mountain Mahogany.
Cercocarpus intricatus, Mountain Mahogany.
Cercocarpus parvifolius, Mountain Mahogany. *U.*
Kunzia tridentata.
Holodiscus dumosus.
Opulaster monogynus, Ninebark.
Opulaster pubescens, Ninebark.
Opulaster malvaceus, Ninebark.
Rubus deliciosus, Flowering Raspberry.
Amelanchier alnifolia, Serviceberry.
Amelanchier elliptica, Serviceberry.
Amelanchier oreophila, Serviceberry.
Cratægus rivularis, Black Hawthorn.
Cratægus cerronis, Hawthorn.
Cratægus sheridana, Red Hawthorn.
Prunus melanocarpa, Chokecherry.
Prunus pennsylvanica, Wild Red Cherry. *C.*
Acer glabrum, Mountain Maple. *C.*
Acer grandidentatum, Large-toothed Maple.
Ceanothus velutinus, Mountain Balm.
Ceanothus fendleri, Wild Tea Bush.
Ceanothus mollissimus.
Elæagnus argentea, Silverberry.
Cornus stolonifera, Cornel.
Cornus instolonea, Cornel.
Arctostaphylos uva-ursi, Bearberry.
Sambucus canadensis, Elderberry.
Sambucus melanocarpa, Mountain Black Elderberry. *C.*
Viburnum lentago, Sweet Viburnum.
Symphoricarpos rotundifolius, Snowberry.
Symphoricarpos oreophilus, Mountain Snowberry.
Symphoricarpos pauciflorus, Snowberry.
Lonicera glaucescens, Douglas Honeysuckle.
Chrysothamnus wyomingensis, Rabbit Brush.
Chrysothamnus pulcherrimus, Rabbit Brush.
Chrysothamnus parryi, Rabbit Brush.
Chrysothamnus frigidus, Rabbit Brush.
Artemisia tridentata, Black Sagebrush. *U.*
Artemisia cana, Gray Sagebrush. *U.*
Artemisia trifida, Sagebrush.
Artemisia arbuscula, Brown Sagebrush.
Artemisia frigida, Sagebrush.
Artemisia ludoviciana, Sagebrush. *U.*

Herbaceous plants.

Calochortus gunnisoni, Mariposa Lily.
Calochortus nuttalli, Mariposa Lily.
Zygadenus venenosus, Poison Camas. *U.*
Iris missouriensis, Blue Flag.
Corallorhiza multiflora, Coral Root. *C.*
Humulus lupulus, Wild Hop.
Lewisia rediviva, Bitter Root.
Arenaria congesta, Sandwort. *C.*
Clematis ligusticifolia, White Virgin's Bower.
Clematis douglasi, Purple Virgin's Bower.
Clematis occidentalis, Virgin's Bower.

PLANTS—TRANSITION ZONE—Continued.

Herbaceous plants—Continued.

Anemone cylindrica, Anemone. *U.*
Cyrtorhyncha ranunculina, Nuttall Buttercup.
Physaria didymocarpa, Double Bladder-pod.
Drymocallis glandulosa, Glandular Cinquefoil. *C.*
Potentilla effusa, Cinquefoil.
Thermopsis rhombifolia, Yellow Thermopsis.
Lupinus argenteus, Silvery Lupine.
Astragalus succulentus, Ground Plum. *U.*
Astragalus drummondi, Drummond Milk Vetch.
Astragalus hypoglottis, Milk Vetch. *U.*
Astragalus flexuosus, Milk Vetch. *U.*
Astragalus nitidus, Milk Vetch.
Astragalus calycosus, Milk Vetch.
Aragallus lamberti. *U.*
Psoralea argophylla, Silvery Psoralea.
Hedysarum cinerascens, Hedysarum.
Hedysarum uintahense, Uinta Hedysarum. *C.*
Vicia americana, Vetch. *U.*
Geranium fremonti, Geranium. *C.*
Geranium richardsoni, Geranium. *C.*
Linum lewisi, Wild Flax.
Opuntia fragilis, Small-jointed Cactus. *U.*
Echinocactus simpsoni, Simpson Ball Cactus. *C.*
Pachylophus montanus, Evening Primrose. *U.*
Harbouria trachypleura, Water Hemlock. *C.*
Aralia nudicaulis, Wild Sarsaparilla.
Gentiana affinis, Gentian. *C.*
Apocynum androsæmifolium, Indian Hemp.
Phlox depressa, Wild Phlox.
Phlox hoodi, Wild Phlox.
Gilia congesta, Gilia.
Phacelia linearis, Phacelia.
Phacelia heterophylla, Phacelia.
Oreocarya virgata, Oreocarya.
Monarda menthæfolia, Horse Mint. *U.*
Pentstemon laricifolius, Beard-tongue.
Adenostegia ramosa. *U.*
Scutellaria brittoni, Skullcap. *U.*
Mimulus floribundus, Monkey Flower.
Orthocarpus luteus, Yellow Orthocarpus.
Campanula rotundifolia, Harebell. *C.*
Antennaria reflexa, Everlasting.
Balsamorrhiza sagittata, Balsam Root.
Balsamorrhiza incana, Balsam Root.
Chænactis douglassi.

Grasses.

Savastana odorata, Holy Grass.
Stipa nelsoni, Feather Grass.
Muhlenbergia comata, Dropseed Grass.
Agrostis hiemalis, Bent Grass. *C.*
Kœleria cristata, June Grass. *U.*
Poa longipedunculata, Long-stalked Spear Grass. *C.*
Poa lucida, Spear Grass.
Panicularia nervata, Manna Grass.
Festuca ovina duriuscula, Fescue Grass.
Bromus marginatus, Brome Grass.
Bromus porteri, Brome Grass.
Agropyron pseudorepens, Wheat Grass. *C.*
Agropyron caninum, Wheat Grass.
Agropyron spicatum, Wheat Grass. *U.*

Agricultural Utility of the Transition Zone.

The elevated Transition area with its vast extent of grazing lands is now, as in the past, the center of the sheep and cattle industries of Wyoming, and there are also extensive coal and oil fields in various stages of development. The principal timberlands in the Transition Zone are of small extent and lie to the east and northeast. They comprise a moderate growth of yellow pine on the Laramie (see

Pl. V, fig. 1), Casper, and Bear Lodge Mountains, and heavy forests of this valuable timber on the western slopes of the Black Hills.[1]

The climate is cool but dry and healthful, with a rainfall varying from 10 to 12 inches in the arid parts, 12 to 15 inches in the east-central and southeast sections, and 17 to 21 inches in the Black Hills and Bear Lodge districts at the northeast where crops succeed moderately in all except the sagebrush lands. The snowfall is rather heavy throughout. This quantity of moisture, though not large, in a measure counterbalances the cool climate of the Transition Zone and, combined with the much greater area, gives this zone an agricultural value in Wyoming comparable to that of the warmer Upper Sonoran. Large areas of excellent grass land in the mountain valleys and on the higher plateaus in the upper part of the zone are ideal either as cattle range or for the summer grazing of sheep, while a fair growth of range grasses generally obtains even in the lower, more arid sections. The rich soils yield abundantly either under dry farming or irrigation wherever there has been a proper selection of hardy, quick-maturing crops adapted to a usually short growing season.

High-altitude farming has been thoroughly tested at the Wyoming Experiment Station at Laramie for a series of years. Very favorable results[2] were obtained with a great variety of vegetable and cereal crops and even certain fruits, in experiments conducted in the heart of the Transition Zone at over 7,000 feet elevation, where bleak winds are unusually prevalent. Apples and small fruits which are grown with considerable difficulty on the Laramie Plains succeed admirably in many localities with greater natural protection. Successful farming districts in the Wyoming Transition include sections of the Laramie Plains, the Platte Valley above Saratoga, Bear Valley and Fort Bridger region in Uinta County, Salt River Valley in Lincoln County, the eastern base of the Bighorn Mountains in Sheridan and Johnson Counties, and the Sundance region in Crook County. In most of these, oats and hardy cereals, alfalfa (two cuttings), field peas, potatoes, and hardy vegetables are raised to great perfection. Hay, forage, garden vegetables, and a limited crop of small grain are very generally grown on stock ranches even in the colder parts of the zone.

CANADIAN ZONE.

The Canadian Zone, the region of coniferous Boreal forest, is the most important of the Boreal transcontinental life areas. It extends far southward in the principal mountain masses of the Western

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[1] Open sage country usually fills the zone on the basal slopes of the high ranges in western Wyoming. The growth of Douglas spruce along its upper border in this region is generally scattering, while the yellow pine is of rare occurrence.

[2] Discussed in bulletins of the Wyoming Experiment Station, which contain also valuable cultural and other data based on tests made at the station at Laramie and at the experimental farms at Sundance and Saratoga.

States, and over much of the Rocky Mountain region covers the middle slopes of the high ranges and the summits and upper slopes of mountains of medium elevation. It is uniformly and conspicuously characterized from Montana to Colorado by forests of spruce, fir, lodgepole pine, and aspen, and by a large variety of Boreal undershrubs and plants.

In Wyoming the greatest extent of Canadian Zone country is in the mountainous northwest. Here the zone includes most of the extensive undulating forested plateau of Yellowstone Park; large rolling or hilly tracts of mixed forest and open country on the borders of Jackson Hole (Pl. VIII, fig. 1), in the basin of Hoback River, at the head of Green River, and on the southern end of the Wyoming Range; and the forested slopes of the Wind River, Absaroka, Teton, Gros Ventre, Salt River, Snake River, and Wyoming Ranges (Pl. VIII, fig. 2) from near their bases to the upper limit of large tree growth at 9,000 to 10,000 feet elevation. Elsewhere the Bighorn and Medicine Bow Ranges and the Sierra Madre are extensively Canadian, and the Laramie Mountains and Casper Range have considerable areas on their summits. Elevations of medium altitude which are capped with Canadian Zone forests and also have small areas on their cool slopes are the Black Hills, the Bear Lodge, Rattlesnake, Green, Ferris, Seminole, and Shirley Mountains, the northern shoulders of the Uinta Mountains, and high plateaus along the southern boundary of the State between Green River and the Red Desert. Traces of the zone, indicated usually by aspens and lodgepole pines, or merely by dense, scrubby thickets of aspens, are on the upper, cool slopes of the Aspen Mountains, the Bear River Divide, a few desert peaks along the continental watershed between South Pass and Steamboat Mountain, on Heart Mountain north of Cody, and on Pyramid and Heaths Peaks along the upper Platte.

The lofty Wind River Range of comparatively straight axis presents a graphic view of the Canadian forest belt, which is maintained usually at uniform elevation and in full vertical width (about 2,000 feet) on both slopes, its lower border sharply defined where the forests meet the open basal sagebrush country of the Transition Zone.[1] The upper border of the Canadian Zone is obscure in these mountains, as elsewhere, the change from heavy forest growth to the narrow Hudsonian timberline belt of dwarfed forest being gradual and almost imperceptible.

The main forest composition on the Wyoming mountains is very uniform, with forests of lodgepole pine and aspen in the lower half of the zone and a heavy stand of Engelmann spruce, or more often a mixed forest of spruce and fir, higher up. Other trees of less extensive growth and more restricted distribution are the Douglas spruce in the lower part of the zone, chiefly in the northwestern mountains; the blue spruce and balsam poplar fringing streams along the lower edge of the zone in the south and west, and in the northwest, respectively; and the canoe birch in the Black Hills and Bear Lodge Mountains. Fire-swept tracts usually are first covered with a dense growth of young aspens, which are of more rapid growth than conifers. In the Sierra Madre the fresh growth on burned-over areas is occasionally of fir over original lodgepole pine forest.

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[1] The lower edge of the Canadian Zone is less clearly marked on the eastern slopes of the Bighorn Mountains and elsewhere in eastern Wyoming where forests of yellow pine fill much of the upper Transition.

In the lower part of the Canadian forest belt are considerable areas of partly open mountain meadows and parks, and more rarely, of open slopes. Characteristic tracts are the 8,000-foot watershed between the Hoback and Green Rivers, where groves of aspen intermixed with a little lodgepole pine and fir alternate over a gently rolling country with open parks covered with low matted sagebrush, *Frasera*, and *Balsamorrhiza*, or with beautiful grassy meadows brilliantly colored in summer with flowers of shrubby cinquefoil, larkspur, lupine, geranium, iris, and painted cup; the grassy meadows and bordering sage benches of the Du Noir Valley at the head of Wind River; extensive willow-grown meadows and flats at the northern end of Jackson Hole and in Yellowstone Park; and open grass or sage slopes on the western side of the Bighorn Mountains between 8,000 and 9,000 feet elevation. On the moderately inclined eastern side of the Wyoming Range southwest of Bigpiney are unusually open mountain slopes. Here grass and sage country extend in many places on ridges and south slopes to the 10,000-foot crest of the range, alternating regularly with dense tracts of Douglas spruce, lodgepole pine, and Engelmann spruce forest on all north slopes and in gulches.

The usual factors of base level, latitude, slope incline and exposure, and, to a certain extent, air currents, affect in varying degree the altitude of the Canadian Zone. Base level appears to be more potent than latitude in Wyoming. The variation from 8,500 to 10,500 feet on southwest slopes and 7,500 to 9,500 feet on northeast slopes in the mountains along the southern boundary and bordering Green River Basin, to 8,000 to 9,500 feet on southwest slopes and 7,000 to 9,000 feet on northeast slopes in the northern mountains, is largely latitudinal. The depression to 6,000 feet on the cap of the Black Hills and Bear Lodge Mountains, however, is probably due to the low base level of the adjacent plains on the north and east.

The high level of the Canadian Zone (above 8,000 feet) on the warm western slope of the Bighorn Mountains east of Ionia is due to bold southwest exposure, which more than offsets the lowering

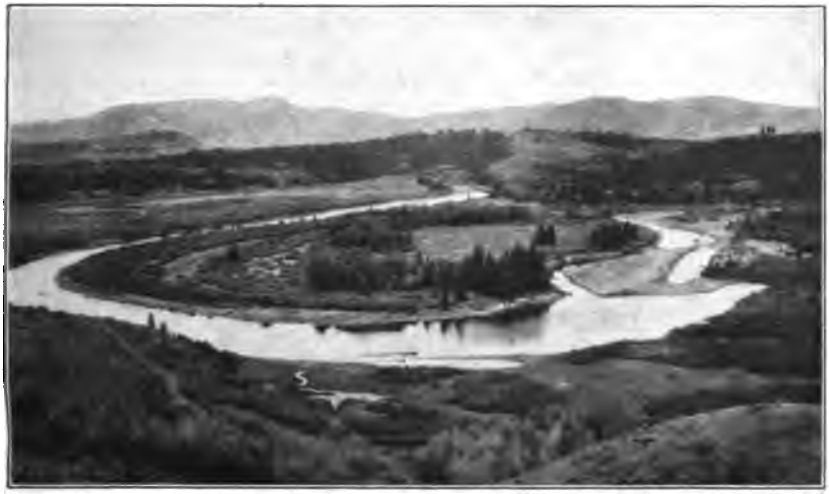

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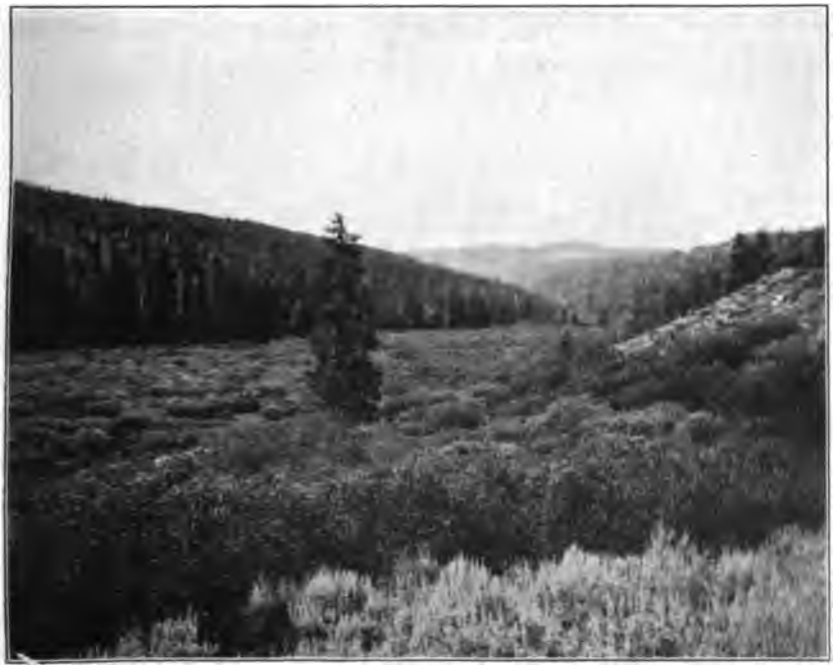
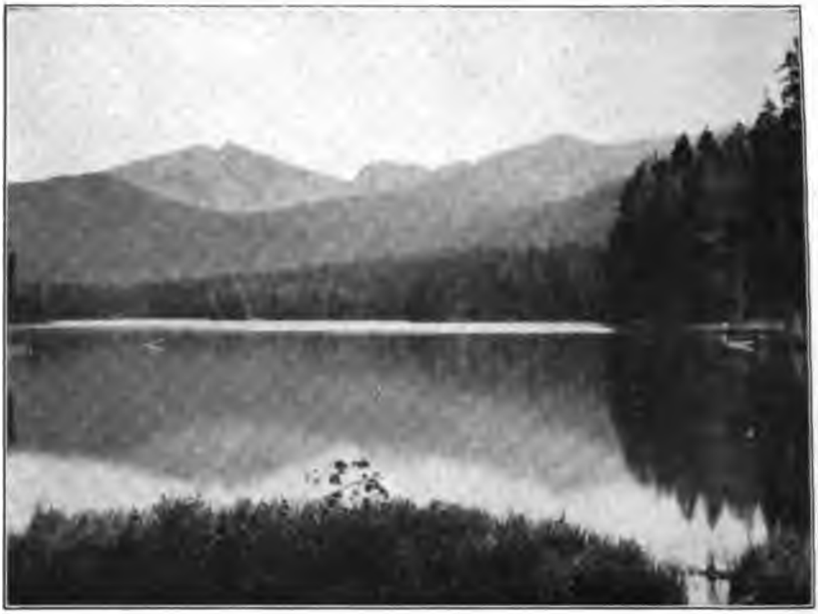
FIG. 1.—SNAKE RIVER VALLEY (6,500 FEET) NEAR MORAN, JACKSON HOLE.

Mixed forest conditions at lower edge of Canadian Zone are shown. Scattered groves of aspen, balsam poplar, and blue spruce on valley flats; aspen and lodgepole pine forests on hills.



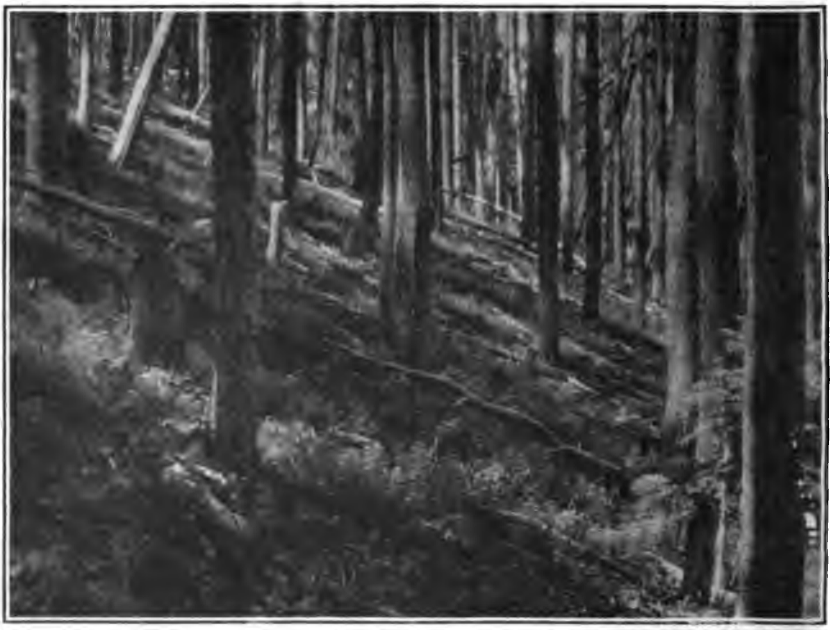
B13670

FIG. 2.—HEAVY ENGELMANN SPRUCE FOREST WYOMING RANGE WEST OF MERNA (9,000 FEET).



B11304

FIG. 1.—SYLVAN LAKE, YELLOWSTONE NATIONAL PARK, IN THE ENGELMANN SPRUCE BELT.



B11[illegible]

FIG. 2.—HEAVY STAND OF LODGEPOLE PINE, NORTH SLOPE OF FERRIS MOUNTAINS (8,500 FEET).

influence of the low altitude of the Bighorn Basin at their western bases. The Ferris and Green Mountains, small isolated ranges on the northern border of the Red Desert, show graphically the effect of slope exposure on zone level. The Ferris Range, of 9,500 feet elevation, is narrow and sharp-crested, with very abrupt southwest slopes facing the desert. These hot, exposed slopes are open Transition Zone, and crowd the Canadian element above 9,000 feet, where it is indicated just below the summit by thickets of aspen and lodgepole pine in gulches, and by Rocky Mountain white pine on exposed slopes and ridges. Just over the 9,500-foot crest on the cool exposure are the Engelmann spruces and firs of the Canadian Zone, somewhat dwarfed at first but soon encountered in large and dense growth. The spruces and firs, with lodgepole pines and aspens lower down, form a heavy forest on the northeast slopes down to 7,800 feet, while descending tongues in gulches along cold streams extend 500 feet lower. The Canadian Zone on the Ferris Range thus exhibits about the maximum variation in zone level due to slope exposure—fully 1,500 feet.

In Jackson Hole, the Yellowstone Valley, along both forks of the Shoshone River, and at the heads of many other narrow valleys deeply penetrating the mountain mass of northwest Wyoming the Canadian element reaches a low elevation, and on cold slopes is often unmixed with Transition species at 6,000 feet. Over this region the mean summer temperature is low, the cold air of the surrounding mass of Boreal country settling into the valleys and canyons at night, and frequent frosts occur during the warmest months. Furthermore, these mainly steep-walled valleys receive a minimum of sunlight, and many slopes are shaded during the warmest part of the day. Under these conditions the zone occasionally has a vertical breadth of nearly 3,000 feet, since the factors which cause the abnormal depression of its lower boundary do not appreciably affect the upper limit.

The cooling influence of cold streams and of descending cold air currents which flow down gulches and canyons regularly carries narrow tongues of Canadian Zone far below the average level on mountain slopes. This is very noticeable on some of the streams at the southwestern base of the Wind River Range. The clear icy waters of Pine Creek, the outlet of Fremont Lake, carry a broad fringe of lodgepole pines, aspens, and a pure Canadian undergrowth almost to its junction with the New Fork at 7,000 feet elevation, fully 1,000 feet below the mean lower border of the zone on the southwest slope of these mountains. The waters of the Big Sandy, 40 miles to the southeast, also carry Canadian species far down into open Transition sagebrush country. Streams which break out of the steep northern escarpment of the Casper Range through deep, shaded gulches are heavily fringed with aspen groves and Canadian undershrubs on the otherwise open 6,000-foot basal slopes, 1,000 feet below the usual altitude of these species on the northern slopes of this range.

The Canadian Zone is marked in Wyoming as a cool region of considerable humidity, but the percentage of bright sunny days throughout the year is high. Much of the precipitation is in the form of frequent sharp showers in summer and heavy snows in winter, but there are occasional rains of greater duration in spring and fall. The chief value of this zone is its natural adaptation, in abundant forest and plant cover and cool summer temperature, to moisture retention.[1] The extensive forests, its greatest natural resource, are now largely under Federal control. These are of great value, especially the forests of lodgepole pine and Engelmann spruce (Pl. IX), but large areas are as yet inaccessible. Winter temperatures are low, occasionally reaching —45° F., and in the small areas physically adapted to agriculture the prevalent summer frosts preclude the growing of more than a few of the hardiest crops and vegetables for ranch use.

Characteristic Species—Canadian Zone.

A rich fauna and flora uniformly characterize the Canadian Zone in Wyoming. Forest species predominate, many of them identical with or closely related to Boreal types of transcontinental range from Labrador to Alaska; others are peculiar to the Rocky Mountain region; and a small number have a restricted range. The canoe birch, beaked hazelnut, Douglas honeysuckle, northern chipmunk, and a few other species of wide Boreal dispersion occur only in the outlying Black Hills and Bear Lodge Mountains at the northeast, and the northern varying hare only in the Bighorn Mountains, but elsewhere the characteristic species are very uniformly distributed in the different mountain ranges. With the exception of many of the breeding birds, which merely make their summer home in the Canadian Zone, all are species adapted to a region of long, cold winters and short, cool summers.

MAMMALS—CANADIAN ZONE.

[Species marked *T.* occur also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Cervus canadensis canadensis, Elk. *T, H.*
Alces americanus shirasi, Shiras Moose.
Sciurus fremonti fremonti, Fremont Spruce Squirrel.
Sciurus hudsonicus baileyi, Bighorn Red Squirrel.
Sciurus hudsonicus ventorum, Rocky Mountain Red Squirrel.
Glaucomys sabrinus bangsi, Rocky Mountain Flying Squirrel.
Eutamias borealis, Northern Chipmunk.
Eutamias operarius, Colorado Chipmunk.

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[1] See pp. 52–53.

MAMMALS—CANADIAN ZONE—Continued.

Eutamias umbrinus, Uinta Chipmunk.
Eutamias luteiventris, Buff-bellied Chipmunk. *T.*
Callospermophilus lateralis lateralis, Say Ground Squirrel. *T.*
Callospermophilus lateralis caryi, Wind River Mantled Ground Squirrel.
Callospermophilus lateralis castanurus, Chestnut-tailed Ground Squirrel.
Marmota flaviventris nosophora, Golden-mantled Marmot. *H.*
Marmota flaviventris luteola, Park Marmot. *H.*
Marmota flaviventris dacota, Black Hills Marmot. *T.*
Peromyscus maniculatus artemisiæ, Sagebrush White-footed Mouse. *T.*
Peromyscus maniculatus rufinus, Tawny White-footed Mouse.
Phenacomys orophilus, Mountain Phenacomys.
Evotomys gapperi galei, Gale Red-backed Mouse.
Evotomys brevicaudus, Black Hills Red-backed Mouse.
Microtus mordax mordax, Rocky Mountain Meadow Mouse.
Microtus longicaudus, Long-tailed Meadow Mouse. *T.*
Microtus richardsoni macropus, Big-footed Meadow Mouse.
Microtus nanus nanus, Dwarf Field Mouse. *T, H.*
Castor canadensis, Beaver. *T.*
Thomomys fossor, Colorado Pocket Gopher.
Thomomys uinta, Uinta Pocket Gopher. *H.*
Thomomys fuscus fuscus, Brown Pocket Gopher.
Thomomys talpoides caryi, Bighorn Pocket Gopher. *H.*
Zapus princeps princeps, Rocky Mountain Jumping Mouse.
Erethizon epixanthum, Yellow-haired Porcupine. *T.*
Lepus americanus americanus, Northern Varying Hare.
Lepus bairdii bairdii, Snowshoe Rabbit.
Felis hippolestes, Mountain Lion. *T.*
Lynx canadensis canadensis, Canada Lynx.
Vulpes macrourus, Mountain Red Fox.
Mustela arizonensis, Arizona Weasel. *T.*
Mustela cicognanii leptus, Dwarf Weasel.
Martes caurina origenes, Rocky Mountain Marten.
Lutra canadensis canadensis, Otter. *T.*
Gulo luscus, Wolverene.
Ursus americanus, Black Bear. *T.*
Ursus imperator, Yellowstone Park Grizzly Bear. *T.*
Ursus washake, Washakie Grizzly Bear, Silver-tip. *T.*
Sorex personatus personatus, Masked Shrew. *H.*
Sorex obscurus obscurus, Rocky Mountain Shrew. *H.*
Sorex vagrans dobsoni, Dobson Shrew.
Neosorex palustris navigator, White-bellied Water Shrew.
Nycteris cinerea, Hoary Bat. *T.*
Lasionycteris noctivagans, Silver-haired Bat. *T.*
Myotis lucifugus carissima, Little Brown Bat. *T.*

BREEDING BIRDS—CANADIAN ZONE.

[Species marked *T.* breed also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Pelecanus erythrorhynchos, White Pelican.
Mergus americanus, Merganser. *T.*
Clangula islandica, Barrow Golden-eye. *H.*
Charitonetta albeola, Buffle-head.
Branta canadensis, Canada Goose. *T.*
Olor buccinator,[1] Trumpeter Swan. *T.*
Dendragapus obscurus richardsoni, Richardson Dusky Grouse. *T.*
Picoides arcticus, Arctic Three-toed Woodpecker.

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[1] Probably no longer breeding in Wyoming.

BREEDING BIRDS—CANADIAN ZONE—Continued.

Picoides americanus dorsalis, Alpine Three-toed Woodpecker. *H.*

Sphyrapicus varius nuchalis, Red-naped Sapsucker. *T.*

Sphyrapicus thyroideus, Williamson Sapsucker.

Selasphorus platycercus, Broad-tailed Hummingbird. *T.*

Nuttallornis borealis, Olive-sided Flycatcher.

Empidonax difficilis, Western Flycatcher. *T.*

Cyanocitta stelleri annectens, Black-headed Jay.

Perisorcus canadensis capitalis, Rocky Mountain Jay. *H.*

Carpodacus cassini, Cassin Purple Finch.

Loxia curvirostra minor, Crossbill.

Spinus pinus, Pine Siskin.

Zonotrichia leucophrys, White-crowned Sparrow. *H.*

Junco hyemalis mearnsi, Pink-sided Junco. *H.*

Junco phæonotus caniceps, Gray-headed Junco. *H.*

Melospiza lincolni, Lincoln Sparrow.

Wilsonia pusilla pileolata, Pileolated Warbler. *H.*

Cinclus mexicanus unicolor, Dipper, Water Ouzel. *T.*

Nannus hiemalis pacificus, Western Winter Wren.

Sitta canadensis, Red-breasted Nuthatch.

Penthestes gambeli, Mountain Chickadee. *T.*

Regulus satrapa, Golden-crowned Kinglet. *H.*

Regulus calendula, Ruby-crowned Kinglet.

Myadestes townsendi, Townsend Solitaire. *T.*

Hylocichla ustulata swainsoni, Olive-backed Thrush. *T.*

Hylocichla guttata auduboni, Audubon Hermit Thrush.

Sialia currucoides, Mountain Bluebird. *T.*

PLANTS—CANADIAN ZONE.

[Species marked *T.* occur also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Trees and shrubs.

Pinus murrayana, Lodgepole Pine.

Pinus flexilis, Rocky Mountain White Pine. *T, H.*

Picea engelmanni, Engelmann Spruce.

Picea parryana, Blue Spruce.

Abies (*concolor ?*), White Fir.

Pseudotsuga mucronata, Douglas Spruce. *T.*

Juniperus sibirica, Low Juniper. *H.*

Populus tremuloides, Aspen.

Populus balsamifera, Balsam Poplar.

Salix pyrifolia obscura, Willow.

Salix nelsoni, Nelson Willow. *H.*

Betula papyrifera, Canoe Birch.

Betula glandulosa, Dwarf Birch.

Corylus rostrata, Hazelnut. *T.*

Alnus tenuifolia, Alder.

Ribes petiolare, Mountain Black Currant.

Ribes wolfi, Blue Currant.

Ribes lacustre, Currant.

Ribes viscosissimum, Currant.

Spiræa lucida, Meadowsweet. *T.*

Rubus parviflorus, Thimbleberry.

Rubus strigosus, Red Raspberry. *T.*

Dasiphora fruticosa, Shrubby Cinquefoil. *H.*

Rosa sayi, Rose. *T.*

Sorbus scopulina, Mountain Ash.

Pachystima myrsinites.

Rhamnus alnifolia, Buckthorn.

Lepargyrea canadensis, Canadian Buffaloberry.

Ledum glandulosum, Labrador Tea.

Menziesia ferruginea.

Vaccinium oreophilum, Mountain Blueberry.

PLANTS—CANADIAN ZONE—Continued.

Trees and shrubs—Continued.

Vaccinium erythrococcum, Red Bilberry. *H.*
Vaccinium occidentale, Blueberry.
Vaccinium cæspitosum, Blueberry.
Sambucus microbotrys, Red Elderberry.
Lonicera glaucescens, Douglas honeysuckle.
Lonicera involucrata, Involucred Fly-honeysuckle.
Lonicera utahensis, Honeysuckle.

Herbaceous plants.

Veratrum tenuipetalum, White Hellebore.
Zygadenus elegans, Beautiful Camas. *H.*
Calochortus pavonaceus, Yellow Mariposa.
Erythronium parviflorum, Dog-tooth Violet. *H.*
Streptopus amplexifolius, Twisted-stalk.
Disporum trachycarpum. *T.*
Limnorchis borealis, Bog Orchid.
Calypso bulbosa, Calypso.
Rumex paucifolius, Dock. *H.*
Claytonia rosea, Spring Beauty. *H.*
Actæa arguta, Baneberry.
Actæa rubra, Baneberry.
Aquilegia cærulea, Blue Columbine.
Aquilegia flavescens, Yellow Columbine.
Aquilegia oreophila, Columbine. *H.*
Anemone lithophila, Anemone.
Aconitum columbianum, Monkshood.
Clematis pseudalpina, Purple Virgin's Bower.
Ranunculus inamœnus, Crowfoot.
Thlaspi glaucum, Penny Grass. *H.*
Parnassia fimbriata, Grass-of-Parnassus.
Heuchera parvifolia, Alum Root. *H.*
Micranthes arguta, Saxifrage.
Fragaria pauciflora, Strawberry. *T.*
Sieversia ciliata, Mountain Avens.
Astragalus alpinus, Milk Vetch.
Trifolium rydbergi, Clover. *T.*
Trifolium anemophilum, Clover. *T.*
Geranium parryi, Geranium.
Geranium cæspitosum, Geranium. *T.*
Viola canadensis rydbergi, Violet.
Viola bellidifolia, Violet. *H.*
Epilobium spp.
Heracleum lanatum.
Pyrola secunda, Wintergreen.
Pyrola uliginosa, Wintergreen.
Pyrola chlorantha, Wintergreen.
Pyrola elliptica, Wintergreen.
Pyrola picta, Painted Wintergreen.
Pterospora andromeda, Pinedrops. *T.*
Chimaphila umbellata, Pipsissewa.
Moneses uniflora, One-flowered Wintergreen.
Gentiana forwoodi, Closed Gentian.
Gentiana elegans, Mountain Fringed Gentian.
Frasera speciosa, Frasera.
Pentstemon glaucus, Beard-tongue.
Pentstemon fruticosus, Beard-tongue. *T.*
Mimulus langsdorfii, Monkey Flower.
Mimulus lewisi, Crimson Monkey Flower.
Elephantella grœnlandica, Elephant-head. *H.*
Pedicularis racemosa, Purple Lousewort.
Castilleja sulphurea, Painted Cup.
Linnæa americana, Twinflower.
Valeriana acutiloba, Valerian. *H.*
Anaphalis subalpina, Pearly Everlasting.
Antennaria pulcherrima, Everlasting. *T.*
Wyethia amplexicaulis.
Arnica cordifolia, Heart-leaved Arnica.

PLANTS—CANADIAN ZONE—Continued.

Grasses.

Phleum alpinum, Alpine Timothy. *H*.
Alopecurus occidentalis, Mountain Foxtail.
Calamagrostis canadensis acuminata, Mountain Reed Grass.
Deschampsia cæspitosa, Tufted Hair Grass. *T*.
Danthonia intermedia, Mountain Oat Grass.
Poa reflexa, Mountain Bluegrass. *H*.
Festuca thurberi, Thurber Fescue.
Agropyron violaceum, Wheat Grass. *H*.
Elymus glaucus, Rye Grass. *T*.

HUDSONIAN ZONE.

On the high mountain ranges of the Western States the Canadian forest belt is fringed along its upper edge by the narrow Hudsonian strip of dwarfed forest and depauperate vegetation, which gives way to bare Alpine slopes along a sharply defined climatic boundary known as timberline, corresponding to the transcontinental limit of trees at the southern edge of the Arctic tundras. The Hudsonian Zone occupies a relatively small area in Wyoming. It encircles the Alpine summits and crests of the northwestern ranges, including the Bighorn Mountains, and small areas cap all ranges or isolated peaks which approximate timberline altitudes. A belt bounds the Alpine cap of the Snowy Mountains at the northern end of the Medicine Bow Range, and small, widely separated tracts or islands are on Bridger Peak and neighboring summits of the Sierra Madre, on Elk Mountain, and on Laramie Peak.

In the southern mountains the forests commence to dwarf almost imperceptibly at from about 10,000 to 10,500 feet altitude, according to slope exposure, the elevation decreasing with higher latitude to 9,000 or 9,500 feet in northern Wyoming. The vertical breadth of the Hudsonian belt varies with slope and soil conditions from a few hundred to 1,000 feet. The peculiar ruggedness and broken, incised character of many mountains greatly obscures this belt, while in places sheer, perpendicular cliffs and avalanches greatly contract it or even narrowly interrupt continuity. Avalanches sweep away every vestige of tree growth and in many places replace the original soil with extensive fields of slide rock. The result is not a climatic change, however, and can not be considered in delimiting the zone. The Hudsonian strip is usually widest in cold gulches with abundant soil, and is narrow on exposed, scantily soiled ridges. In fact, soil conditions often counterbalance the elevating influence of slope exposure, and tree growth may be found as high on cold well-soiled slopes as on warm rocky inclines.

An almost Arctic climate prevails in the Hudsonian Zone, which in winter is buried under deep snow and in summer is flecked with huge drifts, many of which never entirely leave protected gulches. The deep-soiled slopes are thoroughly saturated in summer by melting snow and frequent showers and squalls of snow or sleet, and bogs and small lakes abound in all level situations and natural basins. Exposed to high winds throughout the year, the conifers are in ragged, fantastic, and usually one-sided growth, and, along with the shrubs and many larger plants, evidence an adverse climate in stunted and otherwise deficient development. (Pl. X.) The middle of May found the timberline region on the Wind River Range near Dubois still in the grasp of wintry weather, with few plants in flower and the low willows and shrubby cinquefoil not yet in leaf; while on the Bighorn Mountains east of Hyattville the alpine willows had not put forth leaves by June 5. Many plants were past flowering, and herbaceous vegetation was partly dried up on the Wyoming Range at 10,400 feet altitude, August 9; and the timberline slopes on the Tetons were sere and brown on August 30 except for the hardy, late-flowering blue gentians.

Although the climate is rigorous for eight months of the year and myriads of mosquitoes greet one in summer, this highly interesting region well repays the arduous climb entailed to reach its confines. The gently rounding crests of the Wyoming Range south of Hoback Peak are peculiarly attractive. Grassy openings and parks mingle with scattered clumps and mats of Engelmann spruce and alpine fir; fields of scarlet painted cup, blue larkspur, white columbine, and purple lupine enliven a landscape flecked with white banks of melting snow; and a moderate incline adds to the beauty of the region. The Hudsonian area on the southwest side of the Wind River Range is of very different character. South of Fremont Peak (Pl. XI, fig. 1) it occupies a sloping granitic plateau a mile or two wide, and between 10,500 and 11,200 feet altitude, at the base of abrupt Alpine peaks of nearly 14,000 feet elevation. Its exceedingly rough surface of a seemingly endless succession of bare granite hummocks, studded with countless clear, snow-fed lakes in rocky basins, makes travel extremely arduous. Vegetation is scanty, and coniferous growth is very scattering over this unusually rocky region. Hudsonian vegetation is most abundant on deep-soiled slopes, as on Whiskey Mountain in the Wind River Range south of Dubois, and along the eastern slope of Needle Mountain in the Absaroka Range (Pl. XI, fig. 2).

Characteristic Species—Hudsonian Zone.

Trees of the timberline belt in Wyoming are the alpine fir, white-barked pine, and Engelmann spruce. The first two are characteristic Hudsonian trees, but the spruce extends up from the Canadian Zone. The spruces and firs, mainly on cool exposures, exhibit to a marked degree the depressed growth due to high altitude and are usually prostrate mats at extreme timberline. The white-barked pines of the northwest ranges show less dwarfing, but usually are very ragged and one-sided as a result of the prevalent winds. They occur in scattering growth or as compact tongues push up warm exposed slopes and ridges, and even form forests of considerable size a little below timberline, as on Whirlwind Peak, in the Absaroka Range. The Rocky Mountain white pine, although a tree usually found only at a lower altitude, was found near timberline on the Bighorn Mountains, and also on the exposed 10,000-foot summit of Laramie Peak, where its characteristic growth is in depressed mats at the base of a low central bole 6 feet or more in height. Prostrate clumps of low juniper are common in slide rock at timberline on the Sierra Madre, on the Bighorn and Wind River Ranges, and elsewhere.

Although prominently characterized by depauperate vegetation, the grassy slopes between the scattered clumps of conifers are handsomely carpeted with a wealth of small flowering plants. Conspicuous flowers of spring and early summer, as observed on the Wind River and Bighorn Ranges, include globe flower, mountain cowslip, shooting star, columbine, spring beauty, and various mertensias, Jacob's ladder, forget-me-nots, buttercups, saxifrages, and drabas. In early autumn the timberline region on the Wyoming and Absaroka Ranges was brilliant with flowering mats of lupine, larkspur, painted cup, mountain heath, and mountain laurel, with the more scattering Parry primroses, harebells, gentians, phloxes, and rydbergias.

Many of the plants of the Hudsonian Zone and most of the birds and mammals occur also in the adjoining Canadian or Arctic-Alpine Zones. Comparatively few species are closely restricted to this narrow area.

Mammals—Hudsonian Zone.

Mammals having their center of abundance at or near timberline are the mountain sheep (*Ovis canadensis canadensis*), the timberline chipmunk (*Eutamias oreocetes*), marmots (*Marmota flaviventris nosophora* and *M. f. luteola*), and the pika, or coney (*Ochotona uinta*). A number of species range into this region from the Canadian Zone, or make their homes in both areas. Those occurring thus with some regularity are:

Sciurus hudsonicus ventorum, Rocky Mountain Red Squirrel.

Callospermophilus lateralis caryi, Wind River Mantled Ground Squirrel.

Evotomys gapperi galei, Gale Red-backed Mouse.

Microtus mordax mordax, Rocky Mountain Meadow Mouse.

Microtus nanus nanus, Dwarf Field Mouse.

Thomomys uinta, Uinta Pocket Gopher.

Thomomys talpoides caryi, Bighorn Pocket Gopher.

Lepus bairdii bairdii, Snowshoe Rabbit.

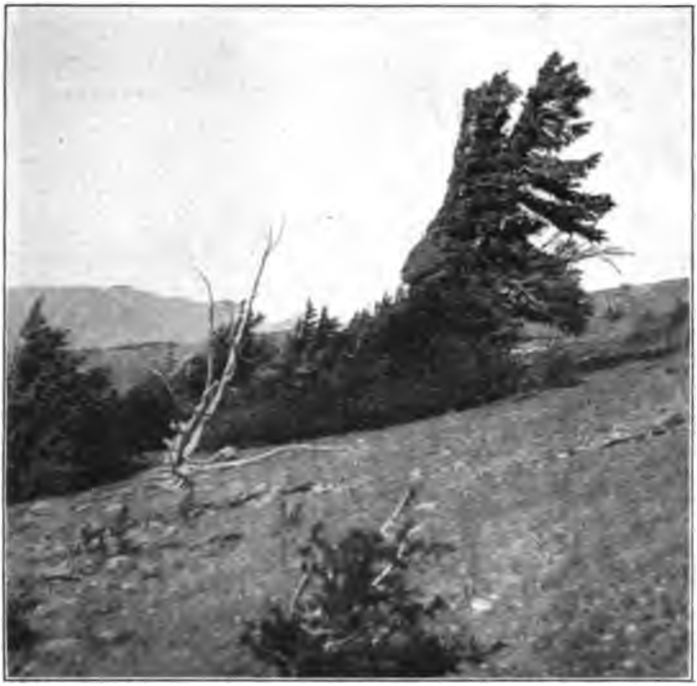
Canis lestes, Mountain Coyote.

Vulpes macrourus, Mountain Red Fox.

Martes caurina origenes, Rocky Mountain Marten.

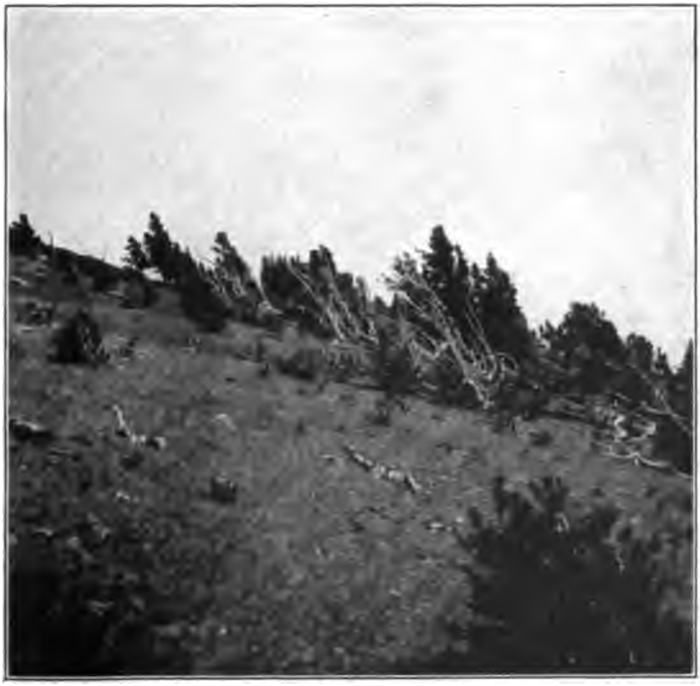
Sorex obscurus obscurus, Rocky Mountain Shrew.

Sorex personatus personatus, Masked Shrew.



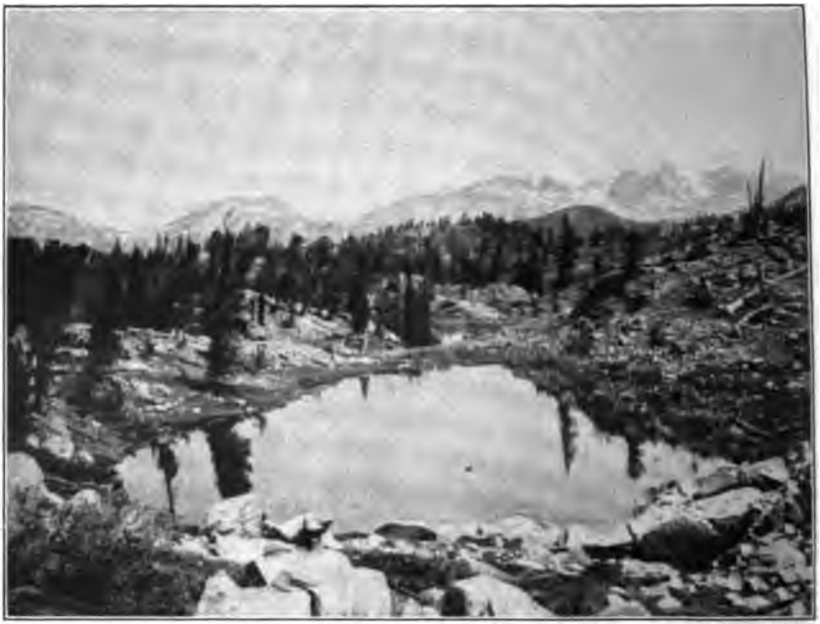
B11790

FIG. 1.—ENGELMANN SPRUCES AT TIMBERLINE, WEST SLOPE OF WHIRLWIND PEAK, ABSAROKA RANGE (10,000 FEET).



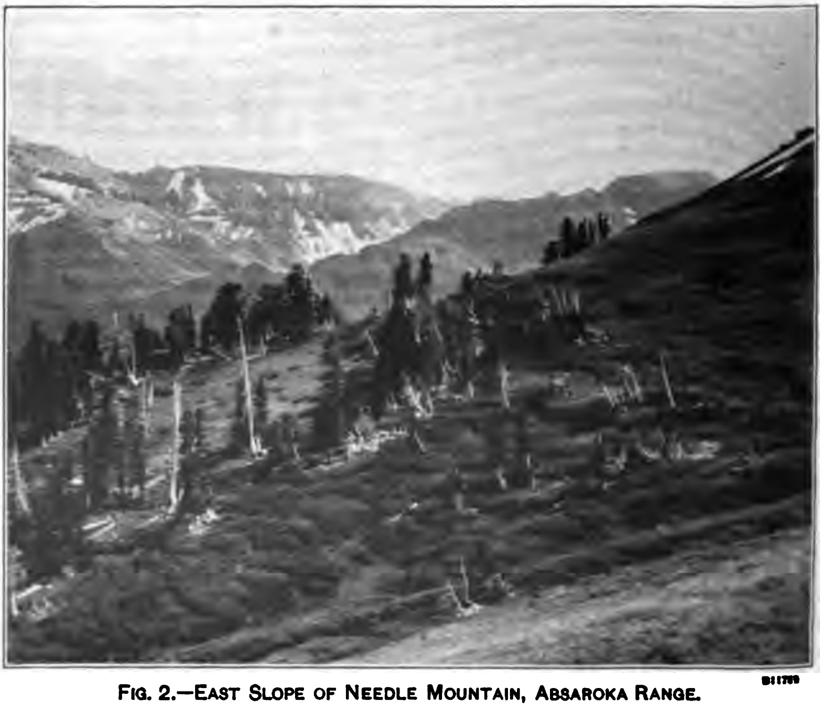
B11791

FIG. 2.—WHITE-BARKED PINES, SAME LOCALITY.



B13041

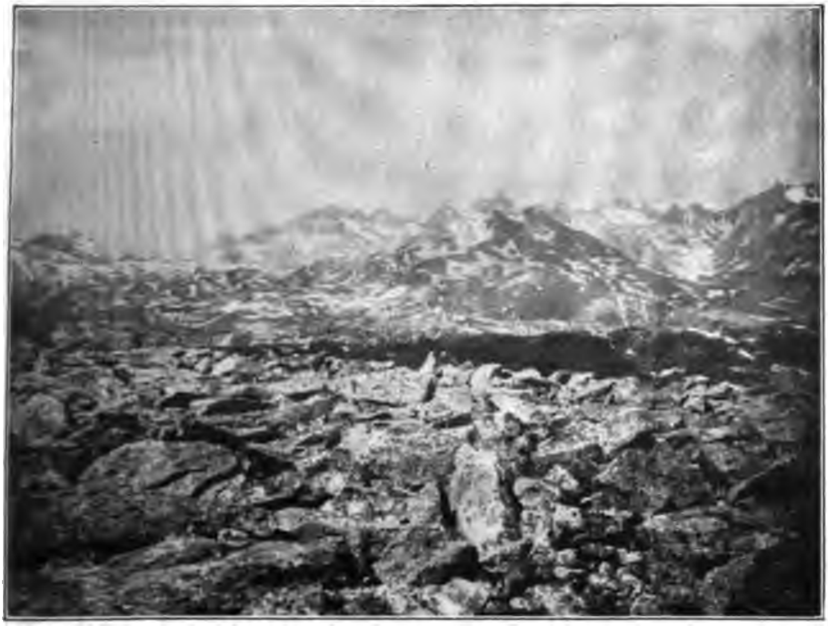
FIG. 1.—LOWER EDGE OF HUDSONIAN ZONE, WIND RIVER RANGE SOUTH OF FREMONT PEAK (10,500 FEET).



B11789

FIG. 2.—EAST SLOPE OF NEEDLE MOUNTAIN, ABSAROKA RANGE.

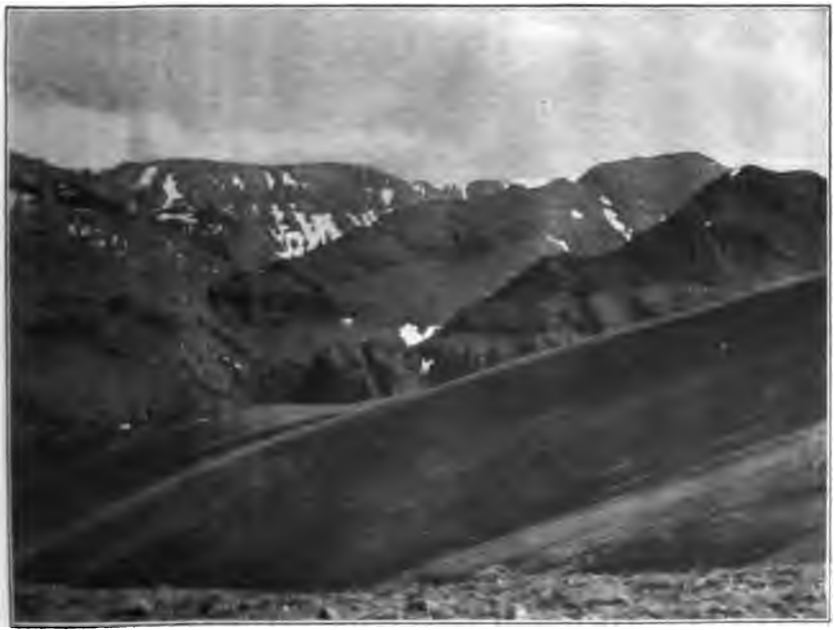
Growth of Engelmann spruce, alpine fir, and gray-leaved willow (*Salix glaucops*) at timberline (10,000 feet).



B13645

FIG. 1.—ARCTIC-ALPINE ZONE, WIND RIVER RANGE.

South of Fremont Peak, from 11,000 feet elevation, July 17, 1911.



B11745

FIG. 2.—ARCTIC-ALPINE ZONE, ABSAROKA RANGE.

Between the Greybull and the South Fork of Shoshone River, from east slope of Needle Mountain (10,500 feet), July 11, 1910.

BREEDING BIRDS—HUDSONIAN ZONE.

[Species marked *C.* breed also in the Canadian Zone.]

Picoides americanus dorsalis, Alpine Three-toed Woodpecker. *C.*
Perisoreus canadensis capitalis, Rocky Mountain Jay. *C.*
Nucifraga columbiana, Clark Nutcracker.[1]
Pinicola enucleator montana, Rocky Mountain Pine Grosbeak.
Zonotrichia leucophrys, White-crowned Sparrow. *C.*
Junco hyemalis mearnsi, Pink-sided Junco. *C.*
Junco phæonotus caniceps, Gray-headed Junco. *C.*
Wilsonia pusilla pileolata, Pileolated Warbler. *C.*
Certhia familiaris montana, Rocky Mountain Creeper. *C.*
Regulus satrapa, Golden-crowned Kinglet. C.

PLANTS—HUDSONIAN ZONE.

[Species marked *C.* occur also in the Canadian Zone; those marked *A.*, also in the Arctic-Alpine.]

Pinus albicaulis, White-barked Pine.
Picea engelmanni, Engelmann Spruce (dwarf). *C.*
Abies lasiocarpa, Alpine Fir (dwarf). *C.*
Juniperus sibirica, Low Juniper. *C.*
Salix glaucops, Gray-leaved Willow.
Salix chlorophylla, Willow. *C.*
Salix saximontana, Willow. *A.*
Ribes montigenum, Bristly Red Currant.
Rubus strigosus, Red Raspberry. *C.*
Polygonum bistortoides, Twisted Polygonum. *C.*
Claytonia rosea, Spring Beauty.
Calandrinia pygmæa, Alpine Bitter Root.
Cerastium beeringianum, Mouse-ear Chickweed.
Caltha leptosepala, Mountain Cowslip.
Trollius albiflorus, Globe Flower.
Aquilegia saximontana, Columbine.
Delphinium subalpinum, Larkspur.
Anemone tetonensis, Anemone.
Anemone globosa, Anemone. *C.*
Ranunculus alpeophilus, Buttercup.
Ranunculus calthæfolius, Buttercup.
Thlaspi glaucum, Penny Grass.
Draba luteola, Whitlow Grass.
Clementsia rhodantha, Red Orpine. *A.*
Leptasea hirculus, Saxifrage.
Potentilla glaucophylla, Cinquefoil. *C.*
Drymocallis pseudorupestris, Avens.
Lupinus cæspitosus, Lupine. *C.*
Lupinus laxiflorus, Lupine. *C.*
Trifolium dasyphyllum, Dwarf Clover. *A.*
Trifolium parryi, Parry Dwarf Clover. *A.*
Hedysarum sulphurescens.
Angelica roseana.
Phyllodoce empetriformis, Mountain Heath.
Kalmia polifolia, Mountain Laurel.
Primula parryi, Parry Primrose.
Androsace subumbellata.
Dodecatheon radicatum, Shooting Star. *C.*
Gentiana calycosa, Gentian.
Gentiana strictiflora, Gentian.
Swertia congesta, *A.*
Swertia palustris, *C.*
Phlox cæspitosa, Phlox. *C.*
Polemonium viscosum, Jacob's Ladder.
Polemonium mellitum, Jacob's Ladder.
Phacelia sericea, Silky Phacelia. *A.*
Myosotis alpestris, Forget-me-not. *A.*
Mertensia tweedyi, Lungwort. *C.*
Pentstemon alpinus, Beard-tongue.
Veronica wormskjoldi, Alpine Speedwell.
Veronica serpyllifolia, Speedwell. *C.*
Castilleja spp., Painted Cup.
Campanula parryi, Parry Harebell.
Rydbergia grandiflora, Rydbergia. *A.*

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[1] Young noted in summer.

PLANTS—HUDSONIAN ZONE—Continued.

Townsendia parryi, Parry Townsendia. *A.*
Senecio fremonti, Paintbrush. *A.*
Senecio crassulus, Paintbrush.
Antennaria reflexa, Everlasting.
Erigeron compositus, Fleabane. *C.*
Erigeron salsuginosus, Fleabane.
Chænactis alpina, Alpine Chænactis.
Trisetum subspicatum, Oat Grass.
Poa epilis, Bluegrass. *A.*
Phleum alpinum, Alpine Timothy. *C.*
Carex nigricans, Sedge.
Carex nova, Sedge.
Juncus subtriflorus, Rush.

ARCTIC-ALPINE ZONE.

The area above timberline on the highest mountains, the Arctic-Alpine Zone, corresponds in climate, and in plant species especially, to the barren grounds of the Arctic. It is not continuous from one range to another in Wyoming, for even in the mountainous northwest the areas are separated, often widely, by Canadian Zone valleys and forested divides of medium elevation.

A wide, almost unbroken stretch of this zone caps the massive Wind River Range for its entire length (Pl. XII, fig. 1), and there is a broken, irregular area of equal extent on the main crest and primary spurs of the rugged Absaroka Range (Pl. XII, fig. 2). The Gros Ventre Range is capped by a succession of Alpine plateaus sloping moderately toward the north, while the lofty peaks and jagged crests of the Tetons form a narrow strip of Alpine country. Broad Alpine areas on the Bighorn Mountains lie south of the gap at the head of Tongue River, and include all elevated summits of the Cloud Peak group. There are traces of the zone, too small for plotting on the map (see frontispiece), on a few mountains in the eastern and northwestern borders of Yellowstone Park. In southern Wyoming the Arctic-Alpine Zone is restricted to the lofty plateau on the Snowy Mountains, at the northern end of the Medicine Bow Range.

This high-altitude area is a bleak, wind-swept region of excessive snowfall in winter and frequent squalls of rain, sleet, or snow in the short summer, and arctic temperatures prevail throughout the year. On all the ranges snow fills the gulches and partly covers cold slopes and declivities even in the warmest months, while such massive, elevated ranges as the Wind Rivers, Absarokas, and Tetons carry extensive snow fields, and even a few perennial ice fields or glaciers in protected Alpine valleys.

The Arctic-Alpine Zone is conspicuously marked by the absence of tree growth, which ceases at its lower border. The altitude of timberline varies with latitude and slope exposure from 10,500 or 11,000 feet in the Sierra Madre and the Medicine Bow Range at the south, to 9,500 or 10,000 feet in the Bighorn Mountains and in the Yellowstone Park region.

Characteristic Species—Arctic-Alpine Zone.

The season of plant growth is from the middle of May until August, but during this brief period the bleak slopes and even the fields of slide rock for 1,500 or 2,000 feet above timberline are bedecked with a profusion of bright-hued Alpine flowers. A luxuriant growth of Alpine grasses and sedges obtains wherever there is any depth of soil, and furnishes rich pasturage for mountain sheep and a few other mammals which spend the summer in this usually forbidding region. In Wyoming plant growth rapidly decreases in size above 12,000 feet.

The low shrubby or matted growth usually extending from 500 to 1,000 feet above the limit of trees consists chiefly of dense thickets of willow (*Salix glaucops*) and copses of shrubby cinquefoil (*Dasiphora fruticosa*) which push up the bottoms and along the margins of wet gulches and basins; mats of mountain heath (*Phyllodoce empetriformis*) and alpine avens on rocky slopes and ridges; and spiny red currant (*Ribes montigenum*) and dwarfed raspberry (*Rubus strigosus*) in slide rock. Dwarf alpine willows mat the ground in places for an indefinite distance above timberline, and may even reach the highest summits with the mosses and lichens.

A large number of characteristic Arctic-Alpine herbaceous plants mark the zone in Wyoming, but only four species of breeding birds are peculiar to it, and no mammals.

MAMMALS—ARCTIC-ALPINE ZONE.

The few mammals found in the Arctic-Alpine Zone in Wyoming belong to lower zones. Among those attracted in summer to its grassy slopes and crests are the elk (*Cervus canadensis canadensis*), mountain sheep (*Ovis canadensis canadensis*), timberline chipmunk (*Eutamias oreocetes*), and Wind River mantled ground squirrel (*Callospermophilus l. caryi*). Marmots (*Marmota f. nosophora*), pocket gophers (*Thomomys uinta* and *T. f. fuscus*), meadow mice (*Microtus m. mordax*), coneys (*Ochotona uinta*), and rarely the Uinta spermophile (*Citellus armatus*), apparently are resident in the lower part of the zone in different localities. The coyote (*Canis lestes?*) and mountain red fox (*Vulpes macrourus*) range at various times into Alpine country in search of prey. On the Wyoming mountains mammals are rarely met with above 12,000 feet.

BREEDING BIRDS—ARCTIC-ALPINE ZONE.

Lagopus leucurus leucurus,[1] White-tailed Ptarmigan.

Leucosticte australis,[1] Brown-capped Rosy Finch.

Leucosticte atrata,[2] Black Rosy Finch.

Anthus rubescens,[3] Pipit, Titlark.

Otocoris alpestris leucolæma,[4] Desert Horned Lark.

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[1] On the Medicine Bow Range.

[2] On the Teton, Wind River, and Absaroka Ranges.

[3] Throughout the mountains.

[4] One of the few nesting birds of the Arctic-Alpine, but belonging chiefly to the Transition and Upper Sonoran Zones.

PLANTS—ARCTIC-ALPINE ZONE.

[Species marked *H.* occur also in the Hudsonian Zone.]

Salix petrophila, Rock Willow.
Salix tenera, Rock Willow.
Salix nivalis, Alpine Willow.
Salix saximontana, Creeping Willow. *H.*
Oxyria digyna, Mountain Sorrel. *H.*
Polygonum viviparum, Alpine Knotweed.
Claytonia megarrhiza, Arctic Spring Beauty.
Spraguea multiceps.
Silene acaulis, Stemless Catchfly. *H.*
Alsinopsis obtusiloba, Sandwort.
Paronychia pulvinata, Whitlowwort.
Ranunculus adoneus, Buttercup. *H.*
Thalictrum alpinum, Alpine Meadow Rue.
Arabis lyalli.
Smelowskia americana.
Draba cana, Whitlow Cress.
Draba crassifolia, Whitlow Cress.
Draba densifolia, Whitlow Cress.
Parrya nudicaulis, Purple Parrya.
Rhodiola integrifolia, Rosewort.
Saxifraga cernua, Arctic Saxifrage.
Leptasea flagellaris, Saxifrage.
Boykinia heucheriformis, Saxifrage. Boykinia. *H.*
Dryas octopetala, Alpine Avens.
Sibbaldia procumbens, Sibbaldia. *H.*
Sieversia turbinata, Mountain Avens. *H.*
Lupinus monticola, Mountain Lupine. *H.*
Aragallus nanus, Loco.
Aragallus lagopus, Loco.
Bupleurum americanum, Thoroughwax.
Oreoxis alpina.
Androsace carinata.
Gentiana romanzovi, Dwarf Closed Gentian.
Polemonium confertum, Jacob's Ladder. *H.*
Eritrichium argenteum, Alpine Forget-me-not.
Mertensia brevistyla and others.
Pedicularis parryi, Parry Lousewort. *H.*
Besseya alpina.
Campanula uniflora, Arctic Harebell.
Solidago decumbens, Goldenrod.
Erigeron pinnatisectus, Fleabane. *H.*
Erigeron radicatus, Fleabane. *H.*
Tonestus pygmæus.
Achillea alpicola, Alpine Yarrow.
Artemisia scopulorum, Alpine Sagebrush.
Festuca brachyphylla, Alpine Fescue.
Poa arctica, Arctic Bluegrass.
Poa lettermanni, Bluegrass.
Poa alpina, Alpine Bluegrass. *H.*
Carex engelmanni, Sedge.
Carex albo-nigra, Sedge.
Carex nubicola, Sedge.
Carex atrata, Black Sedge.
Carex phæocephala, Sedge.
Juncoides spicatum, Wood Rush. *H.*

IMPORTANCE OF BOREAL ZONES TO WYOMING AND ADJOINING AREAS.

Climatically and physically unsuited to agriculture, the high altitude Canadian,[1] Hudsonian, and Arctic-Alpine Zones nevertheless are not only a valuable but an essential complement to the lower agricultural areas of Wyoming and most adjoining States. As the chief sources of three great river systems—the Columbia, the Missouri, and the Colorado—their importance is far from local. The great value of the Boreal zones lies in their peculiar adaptation to moisture conservation. This is accomplished climatically on the bleak and barren Alpine slopes and summits, and by plant and forest cover and climate combined in the Hudsonian and Canadian Zones.

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[1] See p. 42.

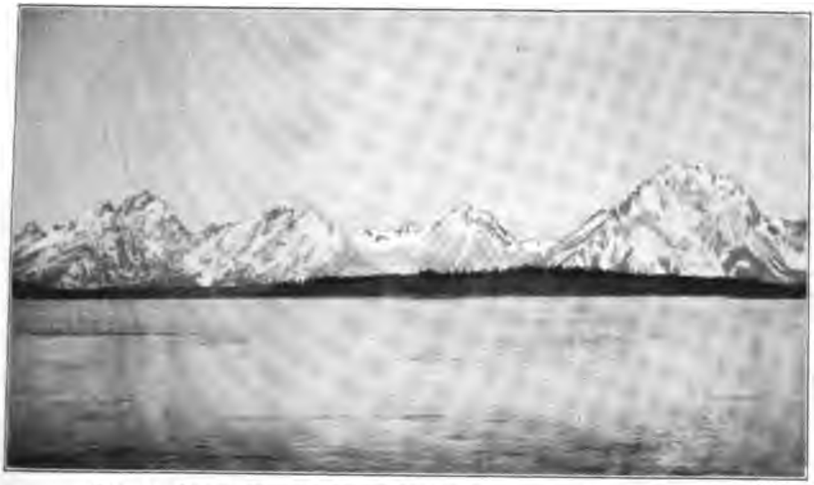

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FIG. 1.—TETON RANGE, MOUNT MORAN SOUTH TO GRAND TETON.

Photograph taken from foot of Jackson Lake, June 5, 1911, by Edward A. Preble.

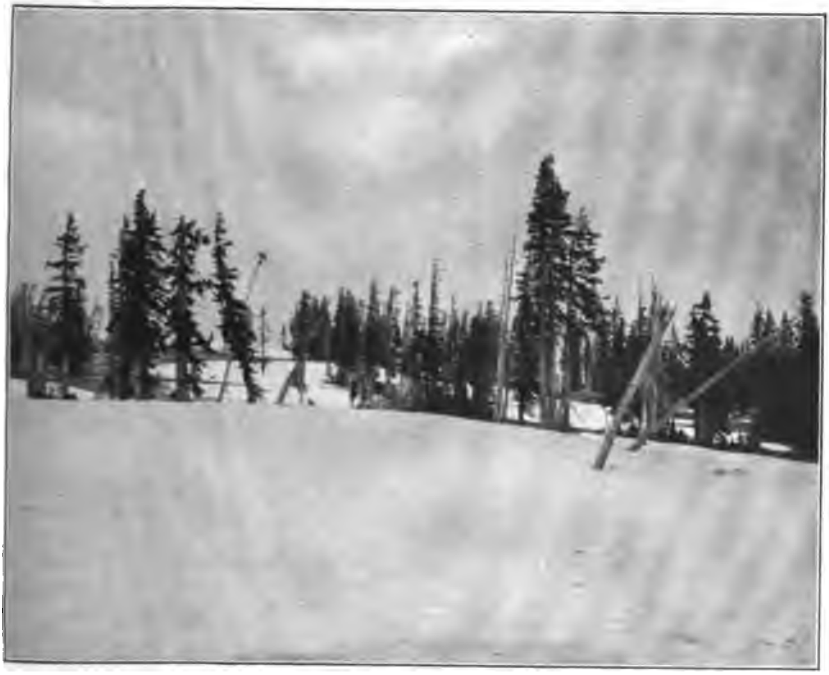

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FIG. 2.—SNOW IN LOWER PART OF HUDSONIAN ZONE (10,800 FEET).

East slope of Bridger Peak, Sierra Madre, July 7, 1911.

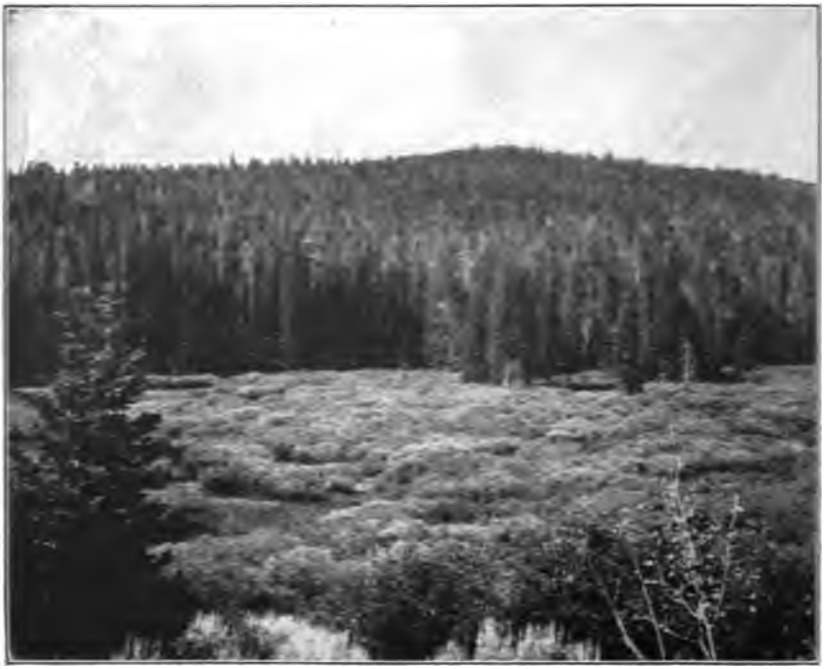

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FIG. 1.—HEAVY FOREST OF ENGELMANN SPRUCE, CANADIAN ZONE, WYOMING RANGE WEST OF MERNA (9,000 FEET).

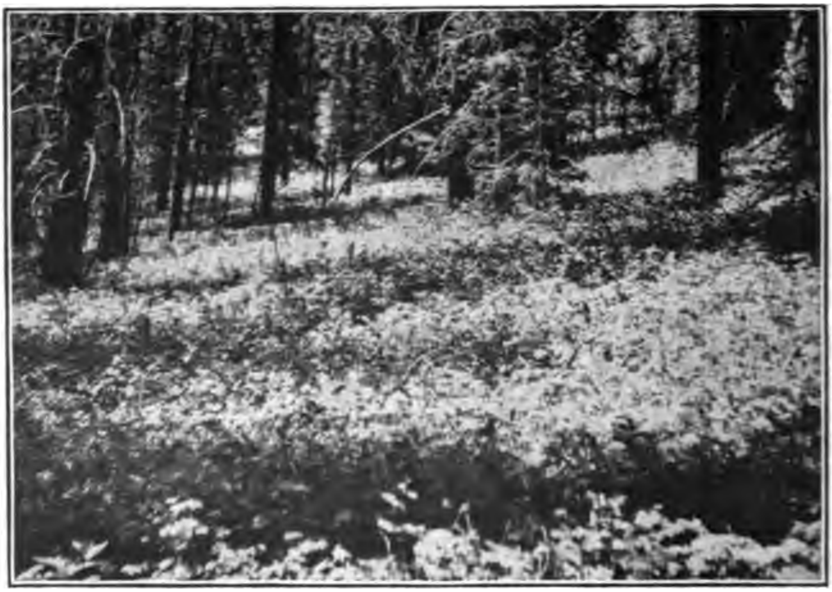

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FIG. 2.—RANK VEGETATION ON FLOOR OF CANADIAN ZONE FOREST, GRINNELL CREEK, ABSAROKA RANGE (7,500 FEET).

A heavy mantle of snow covers the entire Arctic-Alpine cap of the main ranges for seven or eight months of the year (Pl. XIII, fig. 1), while huge drifts and snow fields remain in protected spots throughout the summer. In the timberline region shaded gulches are banked with snow until August, and it is not uncommon to find snowdrifts in the forest depths of the Canadian Zone until midsummer (Pl. XIII, fig. 2), although most of the snow on the lower slopes goes off in flood in May and early June. The summer precipitation is heavy, consisting of rain in the forest belt, and frequent showers and squalls of rain, sleet, and snow on the peaks and higher slopes.

The rotting vegetation and mellow soil of the cool mountain forests are specially adapted to the retention of this moisture, much of which works down from the slowly melting snow banks in the Alpine area. The shaded, mossy forest floor soon becomes saturated, and the water, percolating through the leaves and loose soil, finds its way gradually through rock crevices into ravines and depressions, finally flowing clear and sparkling into the streams lower down. Thus is insured an abundance of pure mountain water to the arid but fertile valleys and plains, and, what is of greatest importance, a fairly uniform volume in the streams toward the end of the growing season, the period when most required by crops. The conversion through irrigation of portions of the valleys of the Snake, Yellowstone, Bighorn, Green, and North Platte Rivers in Wyoming, and especially in neighboring States, as well as of vast tracts as yet undeveloped, into rich agricultural districts is made possible through the combined agency of the climate and the forest and plant cover of the Boreal zones of Wyoming.

The Canadian Zone has large tracts of forest, mainly of lodgepole pine and Engelmann spruce (Pl. XIV, fig. 1), with considerable Douglas spruce on the lower slopes. While these are useful for lumber and other utilities, the intrinsic value is small in comparison with the permanent service they are naturally fitted to perform in connection with the agricultural utilization of the arid regions. Fortunately, most of the timberlands of the Canadian Zone in Wyoming are already included in national forests. Forest control with a view to their conservation is therefore most timely.

While the higher mountain slopes of Wyoming afford a rich pasturage during the summer months for many hundreds of thousands of sheep, careful regulation of sheep grazing is of the utmost importance, as the natural plant cover is a vital factor in catching and holding moisture. (Pl. XIV, fig. 2.) Once this is badly broken up or removed by overgrazing the rains go off with a rush, carrying much of the soil with them. This results in dry, barren slopes, dirty streams, and a greatly diminished flow of water in the lower country during much of the growing season, unless there are adequate water-storage facilities. Mountains which have been extensively grazed include the Wyoming and Salt River Ranges, the southern end of the Wind River Range below the Big Sandy, Sierra Madre, and the mountains on either side of the Bighorn Basin at its southern end. The mountain meadows and parks with their luxuriant grasses constitute an ideal summer range for cattle, and are extensively utilized for this purpose.

Wyoming offers many attractive regions to the tourist, the sportsman, and to those in search of health or recreation. As a permanent pleasure ground the mountainous region at the northwest is a valuable asset, and is perhaps unsurpassed in extent and rugged grandeur. Dashing trout-filled streams add to the attractiveness of a section full of wild charm and beauty, while the dense forests of Yellowstone Park and the northern end of Jackson Hole afford a safe retreat and breeding range, under Federal and State protection, for many thousands of elk and other large game animals, and insure the best of hunting in season in districts adjacent to these protected areas.

NOTES ON THE DISTRIBUTION OF CONSPICUOUS TREES AND SHRUBS OF WYOMING.

The following annotated list of Wyoming trees and shrubs, while very incomplete, includes principally the more conspicuous and characteristic zone species, and should add to the knowledge of their distribution within the State. It is based chiefly on notes and specimens collected by Biological Survey field parties.

Pinus albicaulis Engelmann. White-Barked Pine. (Fig. 3.)

The small white-barked pine in Wyoming is peculiar to the high altitudes of the northwest, where it is a characteristic tree of the Hudsonian Zone just below timberline. It occurs on all the lofty mountains, finding its southern limits in the main chain of the Rockies on the Wind River and Salt River Ranges. At timberline it is often the most abundant tree, especially on parts of the Absaroka Range, but usually shares this bleak region with dwarfed alpine firs and Engelmann spruces, pushing up dry slopes and crests of exposed ridges in ascending tongues, while the spruces and firs occupy wet gulches and the deeper-soiled slopes.

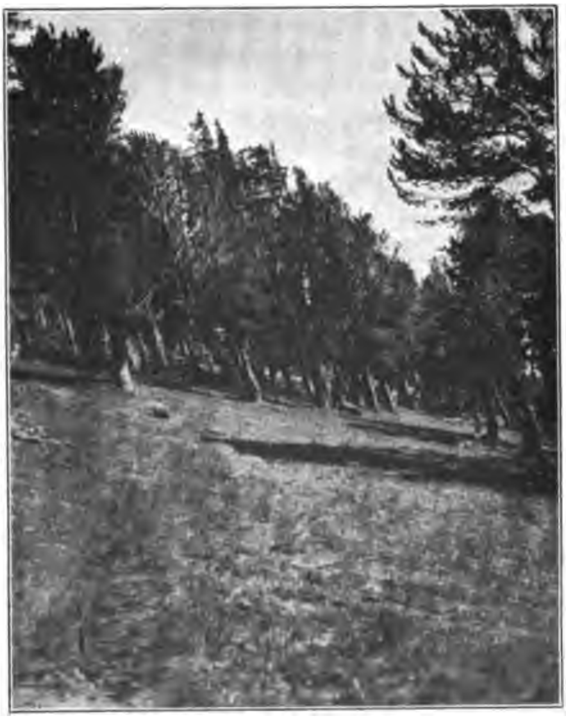

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Fig. 3.—Forest of white-barked pine (*Pinus albicaulis*) just below timberline on west slope of Whirlwind Peak, Absaroka Range (9,800 feet).

Pinus flexilis James. Rocky Mountain White Pine.

The Rocky Mountain white pine has a general dispersion in upper Transition and Canadian Zones in all except the northeast corner of the State. It has its center of abundance with the Douglas spruce along the lower edge of the Canadian forest belt, occupying the ridges and dry slopes, while the spruces are in gulches and on steep, cold exposures. There are few gravel or rocky ridges on the high central and western plains and deserts that do not have more or less of this pine in scattered and usually somewhat ragged growth. In Wyoming it is a small tree, rarely attaining a height of more than 30 or 40 feet or a diameter above 1½ feet under most favorable conditions. Its usual habit of growth is scattering and patchy, but in deep-soiled mountain districts it often produces groves of considerable extent.

Pinus scopulorum (Engelmann) Lemmon. Rocky Mountain Yellow Pine.

The distribution in Wyoming of the Rocky Mountain yellow pine, a well-known Transition Zone tree, is mainly west to the eastern slopes of the Bighorn Mountains and the region of the upper Platte, as follows: Black Hills, heavy open forest to 6,000 or 6,500 feet altitude; Bear Lodge Mountains, moderate growth with oaks, 3,500 to 6,000 feet; Colony, low ridges; throughout the borders of Cheyenne River drainage, in scattering pockets and fringe; watersheds between Belle Fourche and Tongue Rivers, in thin forest over roughest sections; lower eastern slopes of Bighorn Mountains, tolerably wide belt up to 6,000 or 7,000 feet; foothill region of Casper Mountains south throughout the length of the Laramies, including the Hartville group east of the Platte, in usually good growth; divide southeast of Efell; Pine Mountain south of Natrona; borders of North Platte Valley, between Alcova and Leo, and along north base of Shirley Mountains, scattering trees; Seminole Canyon on the Platte, heavier growth; Rock River, ridges; Woods, Medicine Bow Range, some at lower edge of coniferous forest; basal slopes of Sierra Madre south of Downington; and canyons near the mouth of Grand Encampment River. This pine was not found in western Wyoming, although doubtless there are scattering trees on the basal slopes of some ranges.

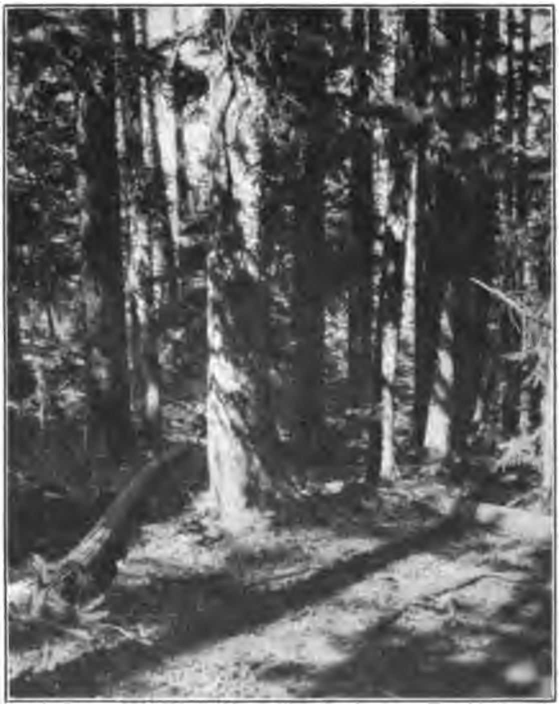

FIG. 4.—Forest of Engelmann spruce (*Picea engelmanni*) on north slope of Ferris Mountains (9,000 feet).

The yellow pine yields valuable lumber mainly in the Black Hills, Bear Lodge and Bighorn Mountains, and on the Laramies in the region north of Laramie Peak. Elsewhere its growth is generally more or less scrubby.

Pinus murrayana Balfour. Lodgepole Pine.

The coniferous element of the Canadian forest belt in Wyoming is chiefly of lodgepole pine and Engelmann spruce. The pines, although occurring throughout the full width of the Canadian Zone, reach their greatest abundance and heaviest and purest stand in its lower half. The best forests are on the main ranges, varying in elevation from 8,500 to 10,000 feet on the Sierra Madre at the south; 8,000 to 9,500 feet on the Wind River Range; and 7,000 to 9,000 feet in Yellowstone Park, the northern Absarokas, and on the eastern slopes of the Bighorns.

The lodgepole pine forests of Wyoming are of great value, but have been extensively levied upon for ranch fences, railroad ties, mine lagging, and lumber, and extensive tracts have been destroyed by fire. The deforested areas are now largely grown up with second-growth pine and aspen.

Pinus edulis Engelmann. Pinyon; Nut Pine.

The pinyon, a small representative of the Upper Sonoran Zone, barely enters Wyoming in the lower valley of Green River. Scattering trees were found at 7,000 feet elevation on the north face of a juniper ridge 3 miles north of the Utah boundary and the same distance east of Green River. The pinyon may possibly occur elsewhere in this rough juniper-clad ridge and mesa country, but it was not detected from Green River east to Red Creek, and thence north to Rock Springs.

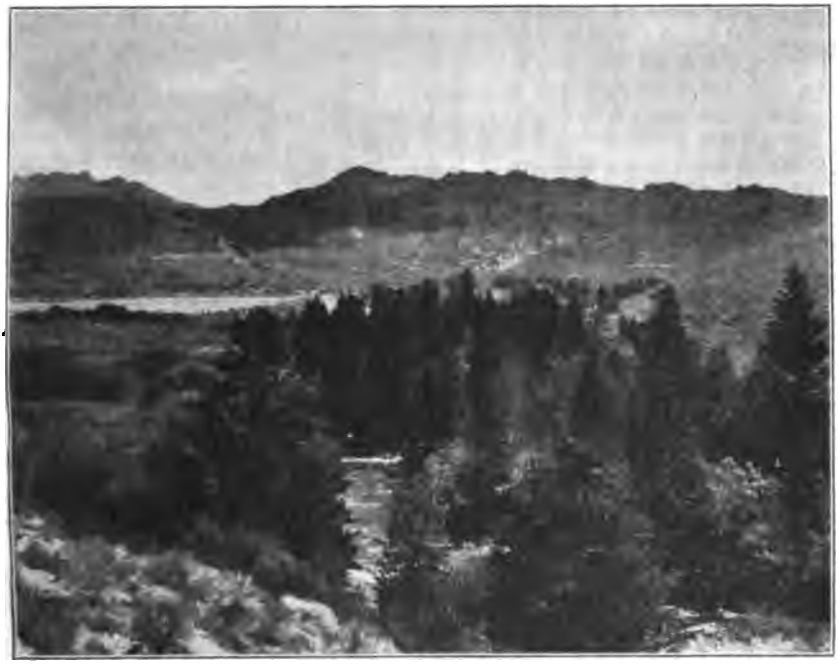

FIG. 5.—Fringe of blue spruce (*Picea parryana*) on the Big Sandy, southwest base of Wind River Range (7,500 feet).

Picea engelmanni (Parry) Engelmann. Engelmann Spruce. (Fig. 4.)

The Engelmann spruce is the principal conifer in the upper part of the Boreal forest belt on the high ranges of northwest Wyoming, and also on the Bighorn, Sierra Madre, and Medicine Bow Ranges. Next to the lodgepole pine it is the most abundant forest tree of Yellowstone Park. Although of regular occurrence at timberline in a dwarfed state, this spruce belongs to the Canadian Zone, attaining its maximum growth on cold, damp slopes and in bogs between 8,000 and 9,000 feet. It does not attain its best development in dry situations or on warm slopes, where it is found at a somewhat higher level.

Picea parryana (Andree) Sargent. Blue Spruce. (Fig. 5.)

The blue spruce occurs chiefly in western Wyoming north to Jackson Lake and the head of Wind River, but was also noted at Woods and in gulches south of Sherman, and should be present elsewhere in the southern mountains. It inhabits the margins of cold streams in the lower border of the Canadian forest belt between 7,000 and 8,000 feet elevation (6,500 to 7,500 feet in Jackson Hole), forming usually a most attractive fringe of scattering symmetrical trees.

Abies lasiocarpa (Hooker) Nuttall. Alpine Fir.

The alpine fir has much the same distribution and vertical range as the Engelmann spruce, although generally less abundant and growing in scattered thicket formation, rarely forming a heavy forest. With the spruce it extends regularly to timberline on the Wyoming ranges, where it is the more common of the two and forms dense prostrate mats on the bleak, wind-swept slopes. This fir is partial to cold gulches, stream banks, and damp spots generally. It may be seen to best advantage in typical growth as dark scattered clumps in aspen woods. While usually a small tree, it attains large size in gulches and on streams in the higher portions of Yellowstone Park, where it forms forests of considerable extent above 8,000 feet altitude. It was observed on all the mountains except the Bear Lodge and Black Hills groups at the northeast.

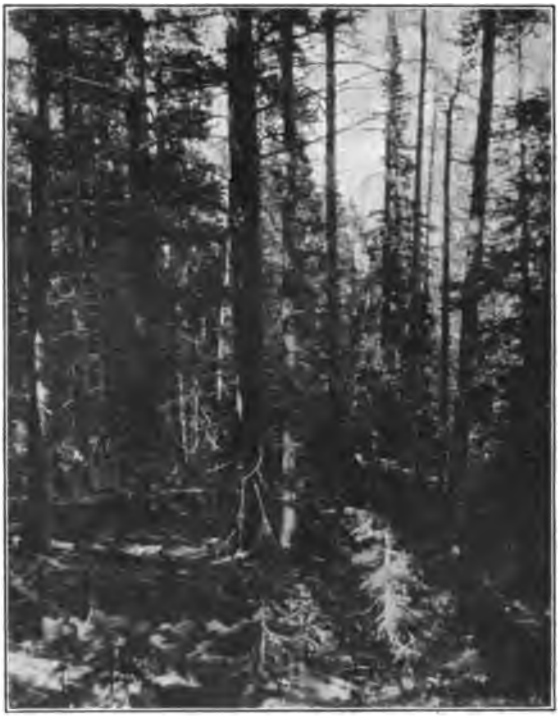

FIG. 6.—Forest of Douglas spruce (*Pseudotsuga mucronata*), north slope of Ferris Mountains (8,500 feet).

Abies (concolor?) Lindley. White Fir.

The white fir (apparently ***Abies concolor***) forms small forests below 9,000 feet elevation on the northern shoulders of the Uinta Mountains west of Lonetree, and is present also in fairly good stand with aspens on the summit of the plateau west of Maxon. Firs which were common at 8,000 feet on the western slopes of the Salt River Range near Afton also had smooth, dark-gray bark and were unquestionably distinct from the light-barked *A. lasiocarpa* on the upper slopes of the same mountains above 9,000 feet. Unfortunately no specimens were preserved from the above localities.

Pseudotsuga mucronata (Rafinesque) Sudworth. Douglas Spruce. (Fig. 6.)

The Douglas spruce has a wide distribution in upper Transition and lower Canadian Zones from the Laramie and Bighorn Mountains westward. It was not observed on the Black Hills or Bear Lodge Mountains. This spruce grows chiefly at the lower edge of the lodgepole pine belt on the main ranges of western Wyoming, reaching down to open sagebrush slopes on their basal flanks, and on the Bighorns and Laramies, extending down into the upper part of the yellow pine belt. It varies locally as to abundance from a thin fringe of scattering trees and thickets on cool declivities and in gulches (which is usual), to a wide belt of heavy pure forest of lumber size.

Juniperus scopulorum Sargent. Rocky Mountain Juniper.

The most conspicuous and widely distributed juniper in the State is the Rocky Mountain juniper, occurring from the barren rocky ridges, canyons, gulches, and badlands bluffs on the Sonoran plains and deserts, up through the Transition Zone, where it mingles with yellow pines, Douglas spruces, and Rocky Mountain white pines on the lower mountain slopes. This juniper is of scattering growth along the bases of mountains and on the margins of the desert basins and valleys, and does not form a well-defined belt along the upper edge of the Upper Sonoran Zone as it often does in the southern Rocky Mountains.

Juniperus knighti A. Nelson. Desert Juniper.

The distribution of the desert juniper is imperfectly known, owing to very scattering field work in the difficult Red Desert region which it inhabits. The few localities from which there are specimens indicate a restricted range, mainly in the Upper Sonoran Zone. S. G. Jewett collected the species at Mountainview, on May 27, 1913, and it appears to be the dominant juniper at Rock Springs, near Carter, and in the badlands to the south and east of Lyman. On the Green River bluffs near the Utah boundary *Juniperus monosperma* is not uncommon, and on the higher borders of the Red Desert *J. scopulorum* is the common species. The desert juniper is usually of shrubby stature, branching from the base, and scarcely attains the dignity of a tree. Nelson found the species on the sandstone bluffs of the Bitter Creek drainage, and records specimens from Point of Rocks and Rock Springs.[1]

Juniperus monosperma Engelmann. One-Seeded Juniper.

The one-seeded juniper is found at the northern base of Owl Creek Mountains west and southwest of Thermopolis; at Hailey, southeast of Lander; along the Platte near Alcova in canyons and on dry slopes up to 6,300 feet elevation; and on the rough breaks along the lower Green River Valley, particularly on the east side between Sage Creek and the Utah boundary. It is tolerably common on the Snake River bluffs near Baggs and is probably the species which forms a considerable belt along the western bases of the Sierra Madre. It was noted only in the Upper Sonoran Zone, extending up to 7,500 feet on the hot slopes east of Green River near the State line.

Juniperus sibirica Burgsdorff. Low Juniper.

The low juniper, a graceful evergreen, is a characteristic undershrub in the Boreal forest belt throughout the Wyoming mountains. On most of the loftier ranges it extends to timberline, where it forms dense prostrate mats among rocks. Its center of abundance is in the Engelmann spruce and lodgepole pine forests of the Canadian Zone.

Juniperus communis Linnæus. Mountain Juniper.

Not infrequent in mountain forests at lower elevations than the low juniper. The shrubby mountain juniper was noted as follows: Foothills west of Wheatland, 5,500 feet; Springhill; near Sundance; Wolf, north base of Bighorn Mountains, 6,700 feet; head of Pat O'Hara Creek, northwest of Cody.

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[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 54, 1898.

Juniperus sabina Linnæus. Creeping Juniper; Trailing Savin.

Mats of the creeping juniper, or trailing savin, are conspicuous on dry gravel ridges and exposed points and summits of high hills along the northern edge of Wyoming between the Bighorn and Bear Lodge Mountains. The species extends west at least to the eastern base of the Absaroka Range, but is of more general distribution in the northeast. It was not found in other sections of the State. The habitat of this species is in the Transition and lower Canadian Zones.

Populus tremuloides Michaux. Aspen Poplar. (Fig. 7.)

The Boreal aspen poplar is generally dispersed at suitable elevations, but does not, as a rule, reach large size in the Wyoming mountains. It commonly occurs in thickets 10 to 20 feet high on damp, cold slopes, as undergrowth in the coniferous forests, or as first growth on burned-over tracts. Low, scraggy thickets of aspen are on most of the cold slopes and draws above 7,500 feet altitude on barren elevations of the southwest, as the Aspen Mountains, Bear River Divide, and the high plateaus east of Green River near the southern boundary of the State. Beautiful aspen groves were noted, however, between 8,000 and 9,000 feet on the lower southern slopes of the Wind River Range east of Leckie, on the divide between Hoback and Green Rivers, and on the northern shoulders of the Uinta Mountains southeast of Hilliard. The aspen is perhaps the best characterizing tree of the Canadian Zone.

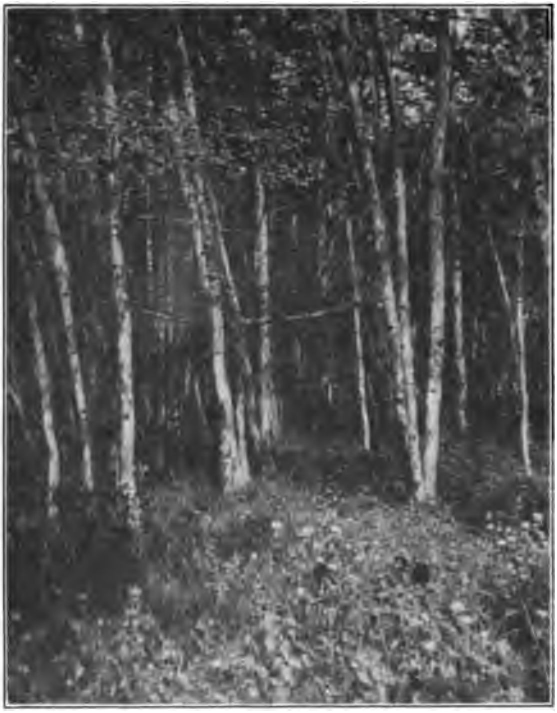

FIG. 7.—Grove of aspen poplar (*Populus tremuloides*) near Springhill, north base of Laramie Peak (6,000 feet).

Populus balsamifera Linnæus. Balsam Poplar.

The balsam poplar inhabits the borders of many of the larger streams in the northwestern mountains, being largely confined to the Canadian Zone between 6,500 and 7,500 feet elevation. It occurs south in the Jackson Hole country at least to the Gros Ventre River. Scattering trees are found also in wet gulches at the southern base of the Bear Lodge Mountains near Sundance at about 5,000 feet elevation.

Populus occidentalis (Rydberg) Britton. Broad-Leaved Cottonwood.

The broad-leaved cottonwood, characteristic of the Upper Sonoran Zone, forms the principal fringe on the streams of eastern and northern Wyoming, attaining perfection of growth in the lowest and warmest valleys. Large groves border the Bighorn, Belle Fourche, and especially the streams of the lower Platte drainage. There is a great deal of cottonwood growth on the Cheyenne River and other streams southwest of the Black Hills, but in this section the species grows in a very stunted state, low and irregular and very thick at the the base. In the Wheatland district it occurs in places in heavy growth with *Populus acuminata*, and along the base of the mountains generally meets and commingles with the narrow-leaved Transition species, *P. angustifolia.*

Populus acuminata Rydberg. Lance-Leaved Cottonwood.

On the Chugwater, Sibylee, and other tributary streams of the Laramie and North Platte Rivers east of the mountains the lance-leaved cottonwood forms in many places a heavy fringe with *Populus occidentalis*, though by no means so generally distributed as the latter species. A splendid growth of the lance-leaved cottonwood is on Sibylee Creek southwest of Wheatland. The species was not noted in northern Wyoming, but at the west scattering trees are on Green River, just north of the Utah line.

Populus angustifolia James. Narrow-Leaved Cottonwood. (Fig. 8.)

The narrow-leaved cottonwood inhabits the borders of mountain streams in the Transition Zone, mainly at elevations from 6,000 to 7,500 feet at the west, extending down to 5,000 feet in the central districts, and to 4,500 feet at the eastern base of the Bighorn Mountains. It is apparently absent from the northeastern part of the State. Important streams bordered with good growth include the Bear, Green, Wind, and Greybull Rivers, the north and south branches of the Shoshone River above the forks, Snake River below the mouth of the Gros Ventre, and the upper North Platte down to 18 miles above Casper. Unusually fine groves are on Wolf and Big Goose Creeks, at the eastern base of the Bighorns.

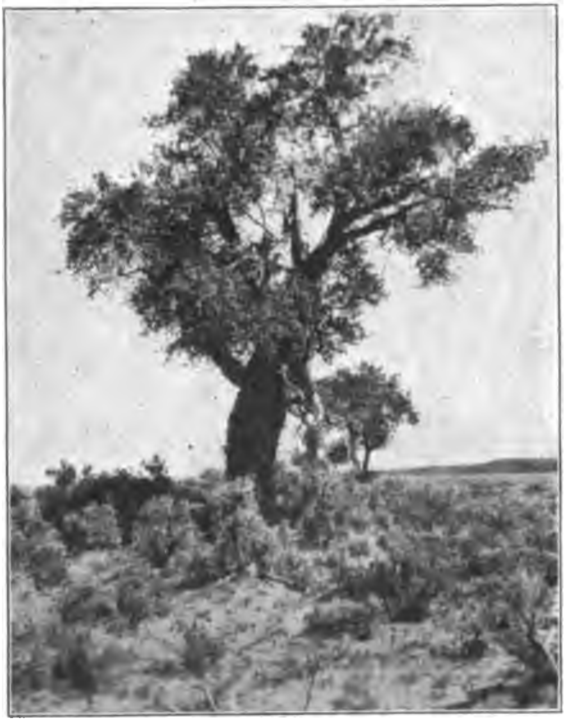

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FIG. 8.—Large narrow-leaved cottonwood (*Populus angustifolia*) on sage flat in upper Wind River Valley.

Salix amygdaloides Anderson. Peach-Leaved Willow.

The large peach-leaved willow occurs in scattered clumps along streams in the Upper Sonoran Zone, chiefly at the east and north, as follows: Chugwater Creek and affluents; Little Bear Creek northeast of Meadow; Sibylee Creek west of Wheatland; Rawhide Creek to base of Rawhide Butte; near Lusk; Hay

Creek east of Aladdin; Wind Creek northeast of Moorcroft; Sheridan; Arvada; Clear Creek, Clearmont to Buffalo; Bighorn River and tributaries near Thermopolis; and Green River near Utah boundary.

Salix bebbiana Sargent. **Bebb Willow.**

The Bebb willow is characteristic on foothill and lower mountain slopes up to about 9,000 feet altitude, and there are few if any ranges in Wyoming where it is not present. The usual growth is in scattered clumps about springs and bogs, but occasionally there is a heavier stand on the margins of mountain streams. The height attained seldom exceeds 12 or 15 feet, and 8 or 10 feet is usual. Specimens were taken on the Laramie, Bear Lodge, Bighorn, and Wyoming Ranges, and at Evanston, while it was observed at a wide range of localities. Nelson records it from Creston, on the open Red Desert.[1]

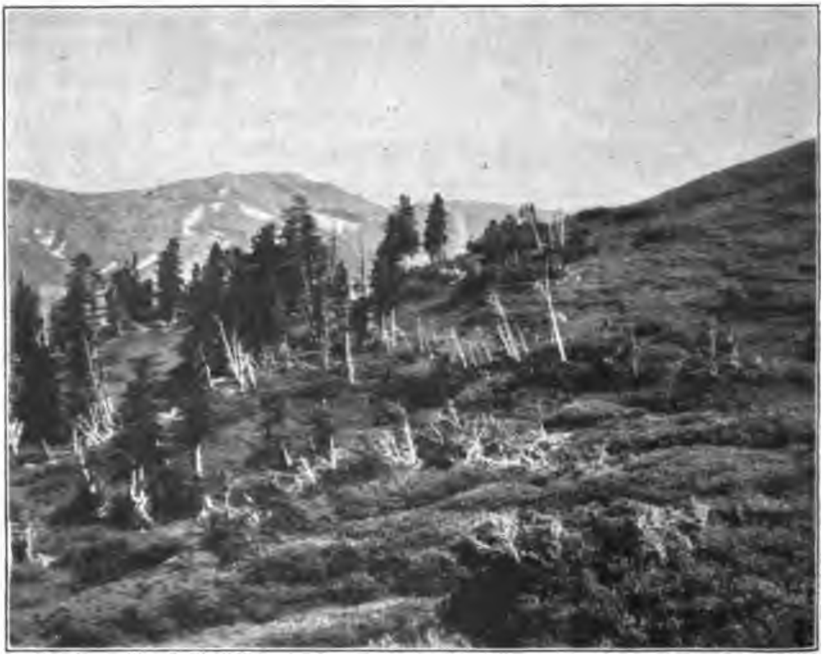

FIG. 9.—Terraced copses of gray-leaved willow (*Salix glaucops*) at timberline, Needle Mountain, Absaroka Range.

Salix pyrifolia obscura Anderson. **Willow.**

Another willow, *Salix pyrifolia obscura*, was collected in the upper forests on the Wyoming Range west of Merna, between 9,000 and 10,000 feet altitude, in the Canadian Zone. It is tolerably common at this locality.

Salix nelsoni Ball. Nelson Willow.

Vernon Bailey collected the Nelson willow along the Hudsonian crest of the Salt River Range at 10,000 feet elevation, August 20, 1911.

Salix glaucops Anderson. Gray-Leaved Willow. (Fig. 9; Pl. XI, fig. 2.)

The gray-leaved willow is a low species of Alpine bogs, growing in dense copses about 2 feet high near timberline on the Bighorn, Wind River, and

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[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 59, 1898.

Absaroka Ranges, and doubtless elsewhere. On Whiskey Mountain, south of Dubois, a few blossoms were out on May 14, 1910, but the leaves had not unfolded. The species was not in leaf by June 5 at timberline on the Bighorn above Hyattville. It was very abundant on Needle Mountain, Absaroka Range, in beautiful terraced copse formation, and likewise on the Wind River Mountains south of Fremont Peak.

Salix petrophila Rydberg. Rock Willow.

The rock willow was collected on the Alpine slopes above timberline at the head of Bull Creek, Wind River Range, in August, 1893, by Vernon Bailey.

Salix tenera Anderson. Alpine Rock Willow.

Low dense mats of the Alpine rock willow, which is very abundant on Whirlwind Peak, in the Absaroka Range, cover portions of these slopes between 10,000 and 11,000 feet elevation.

Salix nivalis Hooker. Alpine Willow.

The dwarf alpine willow is tolerably common on the bleak slopes above timberline on the Wind River Range, occurring among the rocks in dense creeping mats a few inches high. It is abundant south of Fremont Peak from 11,500 feet upward.

Salix saximontana Rydberg. Net-Veined Willow.

More generally dispersed on the Wyoming ranges than the other Alpine willows, but similar in habit of growth, *Salix saximontana* occasionally extends a little below timberline. It is especially abundant at the northern end of the Teton Range, where the creeping mats are very extensive, and push down the cool Hudsonian slopes to 9,500 feet altitude.

Ostrya virginiana (Miller) Willdenow. Ironwood.

Vernon Bailey reports the ironwood as abundant in Sand Creek canyon above Beulah, at the northern base of the Black Hills. The species closely approaches the Wyoming boundary in northwestern Nebraska, 8 or 10 miles east of Kirtley, Wyo., where it is not infrequent in wooded canyons along the northern escarpment of Pine Ridge.

Corylus rostrata Aiton. Beaked Hazelnut.

The beaked hazelnut is abundant on the upper slopes of the Bear Lodge Mountains and Black Hills, forming dense undergrowth in aspen and birch thickets between 5,500 and 6,000 feet altitude. It appears to be absent from the main ranges in Wyoming.

Betula papyrifera Marshall. Canoe Birch. (Fig. 10.)

The canoe birch apparently reaches its southern limits on the Bear Lodge Mountains and northern Black Hills. Over this region it grows to medium size, and with the aspen occurs in dense thickets on cool, shaded slopes and in damp spots as low as 5,000 feet altitude, and on Sundance Creek scattering trees of good size are found at 4,700 feet. On the dry upper slopes of the Bear Lodge Mountains this birch becomes very scrubby. It is apparently absent from the Bighorn Mountains and the ranges of western Wyoming.

Betula fontinalis Sargent. Rocky Mountain Birch. (Fig. 11.)

The Rocky Mountain, or black, birch borders often in dense growth most of the streams on the basal slopes of the mountains, and under the cooling influence of the mountain water extends some distance out onto the plains. At the base of the Bear Lodge Mountains it is common at 4,000 feet altitude, but farther west it is usually present between 6,000 and 7,500 feet. On warm exposed slopes of the Wind River Range north of Big Sandy it extends to 8,000 feet.

Betula glandulosa Michaux. Dwarf Birch.

The dwarf birch was noted only in the mountain valleys of the northwest, from Yellowstone Park (West Gallatin and Lewis River meadows) south to the Wyoming Range (South Piney canyon at 7,500 feet altitude), in the Canadian Zone. This little birch is especially abundant in the extensive willow bogs and swamps bordering Jackson Lake, where it occurs in dense thickets 3 or 4 feet high. Its leaves had mostly turned to a deep Indian red and a few were falling in Jackson Hole by September 13, 1910. It was noted also as follows: Head of Pacific Creek, near Two Ocean Pass; and Horse Creek meadows, at Merna, 8,000 to 9,000 feet.

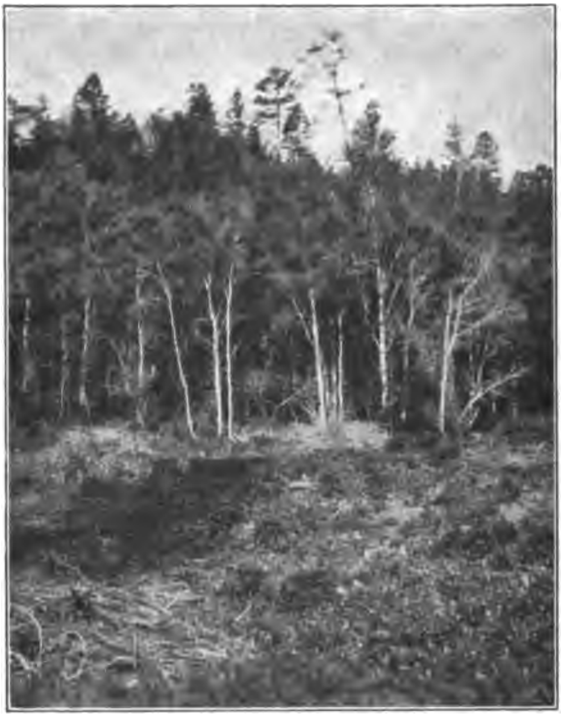

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FIG. 10.—Thicket of canoe birch (*Betula papyrifera*) in gulch near Sundance, Bear Lodge Mountains.

Alnus tenuifolia Nuttall. Alder. (Fig. 12.)

The alder is found in a growth of varying density on the upper reaches of cold mountain streams, and with many other Canadian Zone species follows the cold conditions on their margins down for some distance into the Transition Zone. It is most abundant in the mountainous northwest, and was not noted in the Bear Lodge Mountains or on the northern groups of the Laramie Range.

Ulmus americana Linnæus. Elm.

The elm penetrates Wyoming for a short distance in the low valleys at the northeast. It was common and growing to large size on Sand Creek to 10 miles above Beulah at the northern base of the Black Hills, and on Hay Creek west to Aladdin and Eothen, while it is reported at Hulett in the Belle Fourche Valley. Vernon Bailey found it on Little Powder River near Morse.

Quercus macrocarpa Michaux. Bur Oak.

The bur oak extends into Wyoming from the northeast and is found in abundance over a small area in Crook County, principally east of the Belle Fourche River and north of Linden and Inyankara. It occurs in scattered groves on the partially open basal flanks of the Bear Lodge Mountains and at the northern base of the Black Hills, extending to the dry Bear Lodge summits at 6,000 feet elevation, where Vernon Bailey found scrubby thickets 4 or 5 feet high, loaded with acorns, in August, 1913. In some of the stream valleys the bur oak grows to large lumber size, notably on Sand Creek above Beulah, and many trees were there noted with clean straight trunks of good height from 3 to 4 feet in diameter at the base. The vertical range of this oak is about the same as that of the yellow pine, with which it usually commingles in this region. Vernon Bailey noted a little oak growth near the head of the Little Missouri River, apparently its western limit in the State.

Atriplex canescens James. Saltbush; Gray Shadscale.

The various saltbushes are characteristic Sonoran species of the arid Great Basin region, and barely enter the Great Plains area on some of the dry valley flats at the eastern base of the foothills. They are mostly alkali-resistant and, with the possible exception of *Atriplex canescens*, furnish valuable winter forage for sheep in the central desert sections. Of the three principal shrubby species found in Wyoming, *A. canescens* is the least abundant. It is apparently absent from the Red Desert proper where *A. confertifolia* and *A. nuttalli* abound, but extends farther to the east than either of the foregoing. *Atriplex canescens* occurs in very dense growth 3 feet or more high on dry flats along the Chugwater at Bordeaux, and also in the sand along the Laramie at Uva, but is in scattering growth elsewhere.

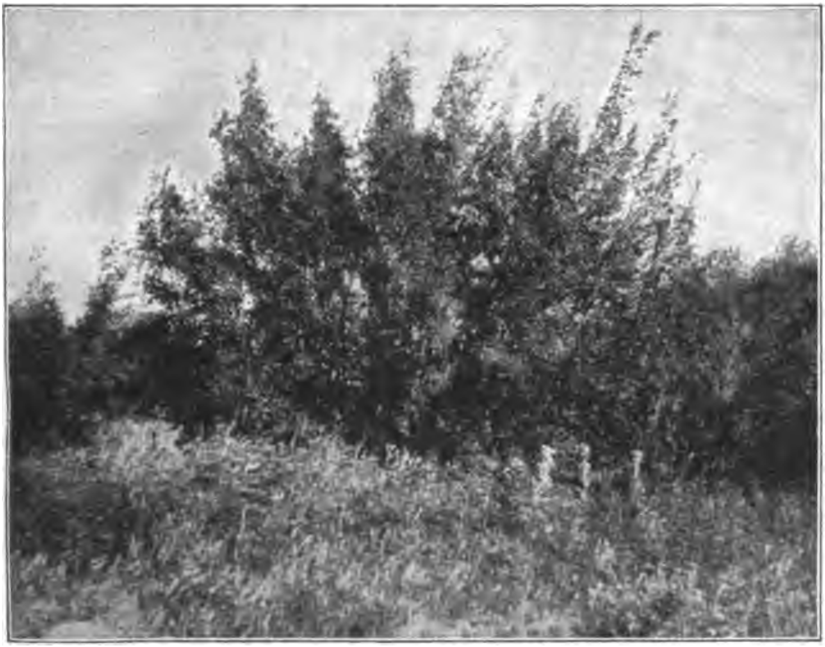

FIG. 11.—Clumps of Rocky Mountain birch (*Betula fontinalis*) 15 feet high, at north base of Shirley Mountains.

Atriplex confertifolia S. Watson. Round-Leaved Saltbush.

The round-leaved saltbush is a low stocky shrub 1 or 2 feet high, very abundant on sandy and alkaline soils up to 7,500 feet elevation on warm slopes east of Green River near the Utah line; bad lands south of Lyman, to 7,000 feet;

Bear River below Evanston, to 6,600 feet; Fossil; Bigpiney; Dubois; Trout Creek, north Shoshone Valley; Bighorn slopes above Hyattville, to 5,500 feet; north base of Rattlesnake Mountains, to 6,500 feet; Splitrock, Sweetwater Valley; east to Fort Steele, Shirley, Old Fort Fetterman, and Arvada.

Atriplex nuttalli S. Watson. Nuttall Saltbush. (Pl. IV, fig. 2.)

The Nuttall saltbush, a low-spreading species, commonly known as "salt sage" to the sheepmen, is of great economic value, as it affords the chief winter food to the flocks on the Red Desert. It has about the same range as *Atriplex confertifolia*, but is seldom found in sand, being partial to dry adobe and saline flats, where it forms often the dominant plant growth. Extensive flats at Frannie and elsewhere in the Bighorn Basin are covered with a pure and uniform growth of this saltbush. The observed eastern limits are Walcott; Little Medicine Bow River west of Marshall; Indian Creek at State line north of Kirtley; Newcastle; and Colony.

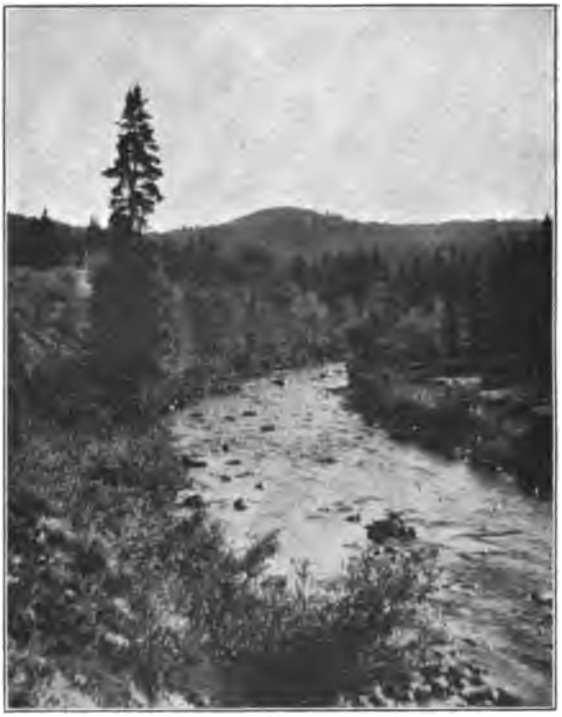

Fig. 12.—Fringe of alder (*Alnus tenuifolia*) on Pacific Creek below Two Ocean Pass.

Grayia spinosa Moquin. Grayia.

A characteristic spiny shrub of the Sonoran desert tracts from the Sweetwater Valley westward, especially abundant in sandy or adobe soils at the lowest levels. On the sandy hummocks between Frannie and Garland at the end of June dense clusters of flat, winged seeds were borne in great profusion on the grayia bushes. These varied from greenish to pink or purple-brown and lent a peculiar hue to the landscape. This shrub has considerable forage value, as its thick leaves and seeds, gathered into drift piles under the bushes, are eagerly eaten by sheep in winter.

Grayia spinosa was common from Independence to Splitrock; Dry Lake to Lorey; on first and second benches above the Platte at Fort Steele; Worland; Manderson; Bonanza; Greybull west nearly to Cody; Rock Springs region; Green River near Utah line; Carter to Lyman; bad lands south of Lyman; Cumberland; Fontenelle to Opal; and Green River flats north nearly to Labarge.

Sarcobatus vermiculatus Torrey. Greasewood. (Pl. IV, fig. 1.)

This common desert shrub is of wide dispersion in the more arid portions of the Upper Sonoran Zone and was noted at numerous localities. It forms a very rank growth on the dry alkaline lake basins and flats of central Wyoming, especially in the Red Desert region, where its dark-green foliage and large size make it the most conspicuous of the alkali-resistant shrubs. The greasewood follows dry adobe valley flats to about 7,000 feet elevation.

Berberis aquifolium Pursh. Barberry; Oregon Grape.

The Oregon grape, a low undershrub, is characteristic of dry forested or partly wooded slopes throughout the State, mainly in the Transition Zone. It is commonly associated with the bearberry, with which it penetrates to the lower edge of the Canadian forest belt. On the Ferris Mountains it was noted at 8,700 feet altitude, and on the west side of the Salt River Range was common to 9,000 feet.

Ribes longiflorum Nuttall. Flowering Currant.

In early summer the brush fringe along streams at the lower elevations is enlivened by the yellow bloom of the flowering currant. This shrub is a characteristic Sonoran species, but is perhaps most conspicuous at the base of the mountains, where it penetrates the foothills for some distance in warm stream valleys. Its upper limits were observed as follows: Foothills west of Wheatland, to 5,300 feet altitude; eastern base of Bighorn Mountains; Greybull River at Meeteetse; Pat O'Hara Creek to 6,000 feet; south slope of Owl Creek Mountains to 7,000 feet; Bull Creek, Wind River Valley; streams of Salt River Valley; Evanston and west slope of Bear River Divide to 7,500 feet; Mountainview; and Henry's Fork of Green River to Burntfork P. O.

Ribes inebrians Lindley. Red Currant.

The red currant is widely distributed in the Transition Zone over most of Wyoming, extending regularly to the lower edge of the Canadian Zone. Flowering specimens were taken in the Laramie foothills west of Islay on June 16, 1909, and near Merna, Wyoming Range, at 8,000 feet altitude, as late as August 10, 1911. This species is partial to rocky situations.

Ribes montigenum McClatchie. Bristly Red Currant.

A high-altitude species, the bristly red currant has a general distribution on the higher Wyoming ranges. It is most abundant near timberline, where it occurs either as scattering bushes in slide rock, or in dense patches a foot or two high on deep-soiled slopes, as on the Wyoming Range west of Merna. It was in flower on the summit of Bridger Peak in the Sierra Madre, on July 7, 1911, and still so on the high Wind River Range south of Fremont Peak on July 18. The red, edible fruit was abundant and fully ripe in the timberline region on the Teton Range on August 30, 1910. It was found in abundance on the high ridge extending north from Needle Mountain, in the Absaroka Range, between 10,000 and 11,000 feet elevation; and also on the Salt River Range, above 9,000 feet.

Ribes lacustre (Persoon) Poiret.

This species occurs in Canadian Zone forests in northwestern Wyoming. It was still in flower near the upper end of Fremont Lake on July 15, 1911, but was bearing fruit on Grinnell Creek, Absaroka Range (8,000 feet altitude), July 30, 1910. Specimens were collected at both localities.

Ribes petiolare Douglas. Mountain Black Currant.

The mountain black currant, a wide-ranging Boreal species, was collected on the summit of the Bear Lodge Mountains on June 20, 1912, where it was not uncommon on the dry crests at 6,000 feet elevation. Flowering specimens were also taken in the Canadian Zone forest near the upper end of Frémont Lake, Wind River Range, July 15, 1911, and fruiting specimens at Tower Falls, Yellowstone Park, August 11, 1910. It is especially abundant in the Yellowstone Park forests.

Ribes viscosissimum Pursh. Currant.

This currant is characteristic of the Canadian Zone forest belt in northern Wyoming. Flowering specimens were taken at 8,500 feet elevation on the head of Shell Creek, Bighorn Mountains, June 5, 1910; near the upper end of Fremont Lake, Wind River Range, July 15, 1911; and at 8,000 feet on Grinnell Creek, Absaroka Range, as late as July 30, 1910. Vernon Bailey collected the species on Wolf Creek, northern slope of the Bighorns, August 10, 1913.

Edwinia americana (Torrey and Gray) Heller. Edwinia.

The low flowering edwinia was found only on the crest of the Laramie Range east of Laramie, between 8,500 and 9,000 feet elevation. Its handsome white cymous bloom enlivened the rock ledges and cliffs on June 18, 1909.

Cercocarpus ledifolius Nuttall. Mountain Mahogany.

The mountain mahogany is a small evergreen tree or stout shrub peculiar to rocky plateaus and ridges and warm exposed basal slopes of mountains. In Wyoming a scattering distribution is indicated from the lower Green River Valley north to Jackson Hole, in the Transition Zone. Most of the rocky ridges adjacent to Green River near the Utah boundary are clothed up to 7,500 feet elevation with dense scrubby thickets from 3 to 6 feet in height. The species was not found farther north in the Green River country, but enters the State from the west along Snake River, and covers in good growth the more exposed of the lower western slopes of the Salt River Range east of Afton and Smoot up to 7,500 feet. Its upper limits in the Snake River drainage are reached apparently near Jackson, where Edward A. Preble found a considerable growth on a warm slope at 7,000 feet in a tributary gulch of Cache Creek.

Cercocarpus intricatus Watson. Mountain Mahogany. (Pl. XV, figs. 1 and 2.)

An abundant evergreen shrub on warm open slopes of the Bighorn Mountains. On the eastern side scattering bushes dot the bare Tongue River bluffs at Ranchester. The species forms dense thickets 3 feet high at about 5,000 feet altitude near Eaton's Ranch, and thence it ascends dry, rocky ridges to 6,500 feet on bare exposed points in the mountains south of Wolf. On the warm western side of the Bighorns above Hyattville *Cercocarpus intricatus* was not seen below 5,800 feet, but between 6,000 and 6,500 feet the dry, hot, reddish slopes were dotted with this intricately branched, steely gray shrub.

Cercocarpus parvifolius Nuttall. Mountain Mahogany. (Pl. II, fig. 1.)

This mountain mahogany occurs mainly in the Transition Zone in Wyoming, although in the southern Rocky Mountains its center of abundance is in the juniper and pinyon belt of the Upper Sonoran Zone. It is partial to warm, rocky situations, either partly open foothill slopes or outlying ridges and buttes on adjacent plains or deserts. The largest growth of mountain mahogany observed was fully 9 feet high, on the pine-clad foothills southwest of Wheatland, at 5,300 feet altitude. The usual height attained is from 4 to 6 feet. Unusually extensive thickets grow on open ridges paralleling the Horse Creek valley between Davis Ranch and Meadow. This shrub flowers early in June, but occasionally a little later. A flowering specimen from Steamboat Mountain was collected June 26, 1913. The distribution of *Cercocarpus parvi-*

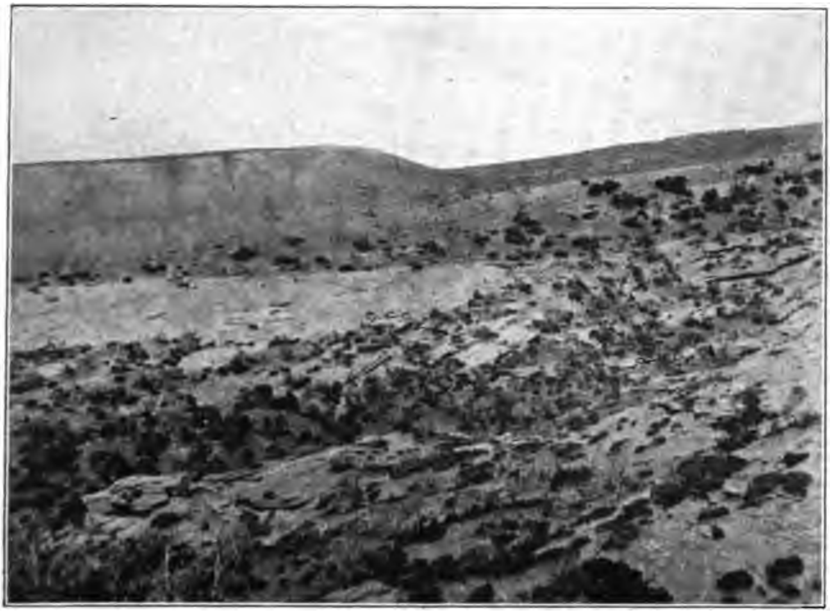

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FIG. 1.—MOUNTAIN MAHOGANY (CERCOCARPUS INTRICATUS).

West slope of Bighorn Mountains above Hyattville (6,000 feet).

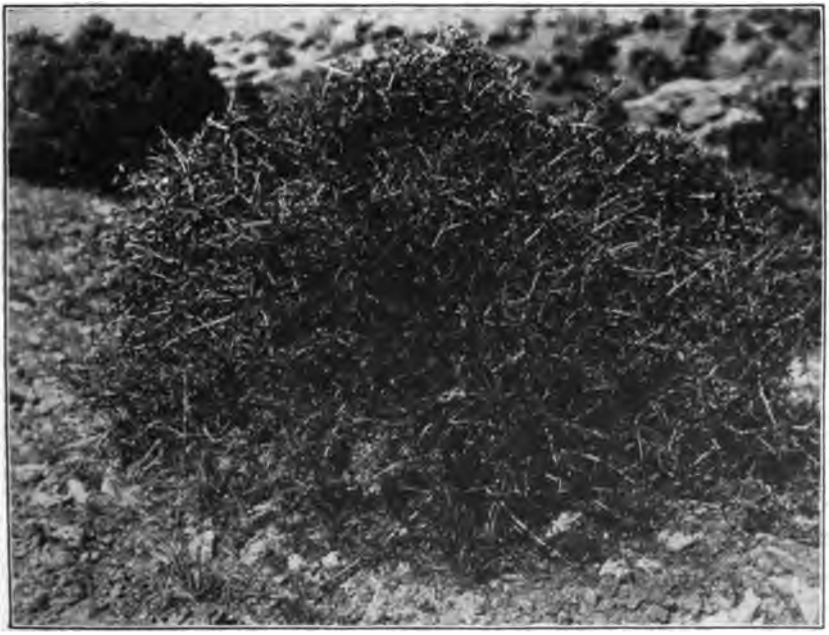

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FIG. 2.—NEARER VIEW OF SAME.

folius as noted by Survey parties is entirely south of a line from Newcastle in the northeast to Evanston in the southwest.

Kunzia tridentata (Pursh) Sprengel. Antelope Brush.

The antelope brush is a common shrub on dry open Transition slopes in southern and western Wyoming, being especially abundant on arid hills, plateaus, and occasional sand ridges in the borders of the Red Desert at elevations between 7,000 and 8,500 feet. It was not noted north of the Wind River, Rattlesnake, and Casper Ranges, but it is not uncommon on dry slopes and sagebrush flats south of Buffalo Creek and the Gros Ventre River in Jackson Hole. With the sagebrush (*Artemisia tridentata*) this shrub regularly ascends warm slopes and occurs in dry parks and openings to the lower edge of the Canadian Zone. Its vertical range varies from 4,500 feet on ridges along the North Platte near Glendo to 9,000 feet on the summits of the Laramie and Ferris Ranges, and also on the warm southern slopes of the Wind Rivers north of Big Sandy.

Holodiscus dumosus (Nuttall) Heller.

Common locally on rocky slopes in some of the dry desert mountains and in the rougher borders of the Red Desert, mainly in the Transition Zone.

Opulaster pubescens Rydberg. Ninebark.

On dry, steep, basal mountain slopes at the head of Pat O'Hara Creek, northwest of Cody, the ninebark forms a low but exceedingly dense chaparral among partly dead Douglas spruce and white pine forests up to 6,500 feet elevation. Along the northern base of the Bighorn Mountains near Wolf it was likewise partial to dry slopes between 5,000 and 7,000 feet.

Opulaster monogynus (Torrey) Kuntze. Western Ninebark.

The western ninebark, a Transition Zone shrub, is tolerably common on the Laramie Mountains and on outlying ridges of the plains region to the eastward, at elevations between 5,000 and 7,000 feet.

Opulaster malvaceus (Greene) Kuntze. Ninebark.

This ninebark is very abundant and conspicuous on the warm western slopes of the Salt River Range near Afton, but was not found elsewhere. Its vertical range in these mountains is from their bases up to 7,100 feet in canyons and to 7,500 feet on warm slopes, and like the other Wyoming species of the genus it is mainly restricted to the Transition Zone.

Spiræa lucida Douglas. Meadowsweet.

The handsome flowering meadowsweet is sparingly present across Wyoming at the north in the lower part of the Canadian forest belt. Alexander Wetmore collected it at 7,000 feet elevation on the east side of Teton Pass on September 9, 1910, and I have observed it down to 5,800 feet in the Bighorn Mountains near Wolf, and in abundance on the Bear Lodge Mountains above 5,500 feet.

Vernon Bailey reports a pink-flowered species, probably *Spiræa densiflora*, between 7,000 and 8,000 feet on the eastern slope of the Bighorns, above Wolf.

Dryas octopetala Linnæus. Alpine Avens.

The low alpine avens is restricted to Arctic and Alpine regions. In Wyoming I collected it on the Bighorn Mountains, where it was in characteristic prostrate matted growth on the rocky slopes above timberline at the head of Trapper Creek, being not yet in flower on June 10, 1910. Vernon Bailey collected it in August, 1893, on the high Wind River Range at the head of Bull Creek.

Rubus deliciosus James. False Raspberry.

The handsome false raspberry was abundant and still flowering on the pine-clad foothill ridges southwest of Wheatland on July 4, 1909, at elevations between 5,000 and 5,500 feet. This is probably near its northern limit, as it was not noted in the Laramie Peak region nor on any of the ranges farther west.

Rubus parviflorus Nuttall. Flowering Raspberry; Thimbleberry. (Fig. 13.)

The flowering raspberry is a tolerably common fruiting species in Canadian Zone woods on most of the Wyoming ranges, especially at the north. The large leaves, showy white flowers in June and early July, and in most years an abundance of handsome red berries in late August, make the thimbleberry very conspicuous in the woodlands between 7,000 and 9,000 feet elevation. The large berries, which are pleasantly flavored, though somewhat dry and seedy, are eaten by many native birds and mammals.

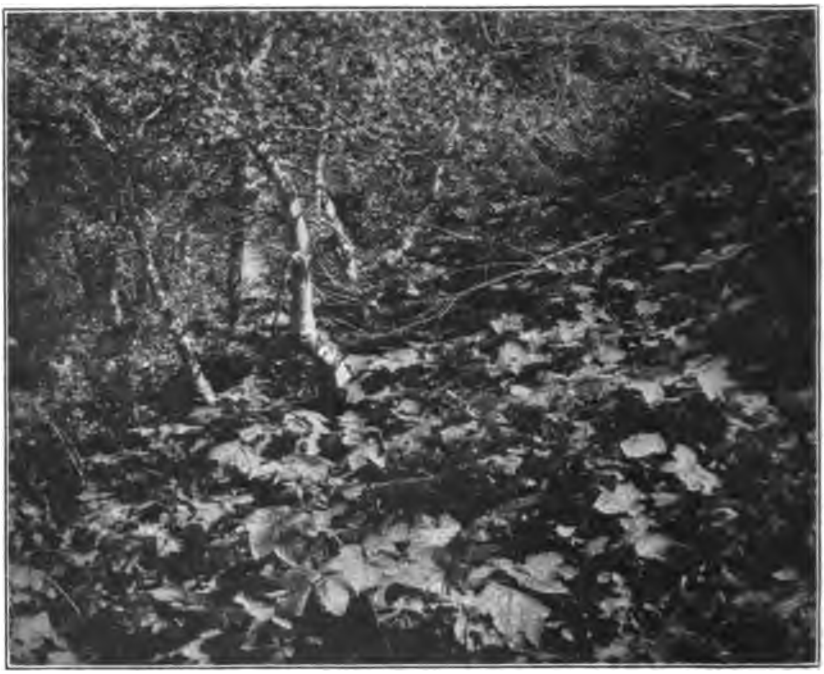

Fig. 13.—Flowering raspberry (*Rubus parviflorus*) in cool gulch, north base of Casper Mountains (6,500 feet).

Rubus strigosus Michaux. Red Raspberry.

The red raspberry is abundant at numerous localities in the mountain districts from the lower edge of the forest belt to timberline. Its observed vertical range is from 4,500 feet at Wolf, at the north base of the Bighorn Mountains, to 11,700 feet, above timberline, south of Fremont Peak, Wind River Range. It reaches its best growth and bears most abundantly on rocky, partially forested slopes in upper Transition and lower Canadian Zones on the northwestern ranges. In the heavy forests between 7,000 and 8,000 feet elevation on Grinnell Creek, in the Absaroka Range, the fruit was just ripening on August 1, 1910, while on the western slope of the Salt River Range the bushes were full of berries on August 20, 1911. In the timberline region the species occurs in a dwarfed state, usually not over a foot high in fields of slide rock. Rock-strewn paths of avalanches throughout the mountains support more or less raspberry growth.

Dasiphora fruticosa (Linnæus) Rydberg. Shrubby Cinquefoil.

The low shrubby cinquefoil inhabits cold mountain bogs and meadows and is more common on the ranges along the western edge of the State than farther east. It is especially abundant in the cold stream meadows along the northern base of the Uinta Mountains, in the upper Green River Basin, and at the head of Wind River; in the willow swamps of Jackson Hole and Yellowstone Park; and in the timberline region on the Wind River and Absaroka Ranges. It extends above timberline on deep-soiled slopes, but at the higher altitudes is depauperate, from a few inches to a foot in height.

Amelanchier alnifolia Nuttall. Serviceberry.

Several species of serviceberry are characteristic of the Transition Zone of Wyoming, but *Amelanchier alnifolia* appears to be of widest range. On the less arid foothills and lower mountain slopes at the east and north, where it is most abundant, it is usually the only species present, but in the central and southern districts it occurs in places with *A. oreophila*, *A. elliptica*, and possibly others.[1] Typical specimens are from the Bear Lodge Mountains. It was noted at localities too numerous for inclusion.

Amelanchier elliptica A. Nelson. Serviceberry.

Taken only in the southwest, where it is the predominating species of *Amelanchier* in the western Transition borders of the Red Desert region at elevations up to 8,000 feet. It was observed at a number of points on the Bear River Divide from Hilliard north to Cokeville, and also in the badlands south of Lyman. S. G. Jewett collected flowering specimens at Spring Valley on June 9, 1912, and also on Steamboat Mountain on June 25.

Cratægus cerronis A. Nelson. Hawthorn.

Several species of hawthorn are represented in Wyoming, where they form a characteristic fringe on streams in the Transition Zone. *Cratægus cerronis* is apparently the predominating form in the Bighorn Mountains, and possibly east to the Black Hills. It was blooming profusely on June 6, 1912, in the heavy deciduous fringe along Wolf Creek, at the northern base of the Bighorns, up to 4,800 feet.[2] Flowering examples were collected at this point.

Cratægus rivularis Nuttall. Black Hawthorn.

The black hawthorn is common in southwestern Wyoming north to the Salt River Valley and Green River Basin and east at least to the upper Platte, at elevations from 6,000 to 8,000 feet.

Sorbus scopulina Greene. Mountain Ash.

In the Wyoming ranges the mountain ash is usually a low or medium-sized shrub 3 or 4 feet high, growing in scattered clumps or occasionally forming small thickets, although in the Shirley Mountains a few clumps 6 feet or more in height were noted. It is very generally distributed in the forests of the Canadian Zone up to 8,500 or 9,000 feet altitude.

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[1] Data collated under *Amelanchier alnifolia* may include some related to other species, being based mainly on field identifications. Unfortunately, few specimens of *Amelanchier* have been preserved.

[2] Vernon Bailey found the hawthorn up to 6,000 feet near Wolf.

Prunus americana Marshall. Wild Red Plum.

Scattered scrubby thickets of wild red plum are met with in gulches and on streams of the northeastern counties east of the Bighorn Mountains, the species being perhaps most abundant on the basal slopes of the Bear Lodge Mountains and at the northern base of the Black Hills.

Prunus pennsylvanica Linnæus f. Wild Red Cherry.

The wild red cherry is sparingly present in northern Wyoming from the upper slopes of the Black Hills and Bear Lodge Mountains west nearly to Yellowstone Park. On the dry, partially open summit of the Bear Lodge Mountains it grows in a dwarfed state. Shrubs not over 2 feet high were flowering profusely at 6,000 feet altitude on June 20, 1912, and considerable fruit was found by Vernon Bailey near Welcome late in August, 1913. Fruit was reddening at the end of July, 1910, on the North Fork of the Shoshone River.

Prunus melanocarpa (A. Nelson) Rydberg. Chokecherry.

The chokecherry is the predominating species of *Prunus*, being omnipresent in the foothills and mountains below 8,000 feet elevation, and on the Laramie Range reaching 9,000 feet. It is most abundant on dry, open, or partly forested Transition Zone slopes, where, however, it occurs usually in low scraggy thickets. It attains its perfection in damp gulches and along streams. The fragrant white bloom is conspicuous in May and early in June.

Amorpha canescens Pursh. False Indigo.

The low silvery false indigo, a shrub of the open Great Plains area, barely enters the State at the northeast in the Belle Fourche Valley. In June, 1912, it was common near Aladdin on open grassy slopes bordering Hay Creek valley.

Rhus rydbergi Small. Western Poison Ivy.

The western poison ivy was occasionally noted at the eastern base of the mountains: base to summit of Rawhide Butte, near Lusk; and Wolf Creek, Bighorn Mountains, below Eaton's Ranch.

Schmaltzia glabra (Linnæus) Small. Smooth Sumac.

The smooth sumac was noted by Vernon Bailey on the lower eastern slopes of the Bighorn Mountains near Wolf, August 10, 1913. It was sparingly present between 4,000 and 6,000 feet elevation in this locality, but has not been noted elsewhere in Wyoming by Survey field parties.

Schmaltzia trilobata (Nuttall) Small. Skunk Bush.

The skunk bush, characteristic of the Upper Sonoran Zone, fringes watercourses at the lower elevations up to 5,000 or 6,000 feet, and on especially warm slopes has been noted at a little over 7,000 feet. The heaviest growth is along streams, as at Greybull, where there are dense thickets 8 or 10 feet high in the cottonwood growth along the Bighorn. A scrubby growth clothes the hot slopes in the bad lands between Greybull and Ionia to a considerable elevation. On Horse Creek north of Cheyenne, and also near Wheatland and Cassa, it grows on valley flats with sagebrush. In the warm districts generally it occurs in scattering growth in dry gulches and on exposed faces of bluffs.

Pachystima myrsinites (Pursh) Rafinesque.

A low evergreen shrub of the Canadian forest belt in Wyoming, chiefly in the western and southwestern mountains. Its vertical limits are approximately 6,000 and 10,000 feet, but it is most abundant between 7,000 and 9,000 feet. On the Salt River Range near timberline it was growing abundantly in a dwarfed state a few inches high. The small green flowers appear quite early, the flower buds being evident on a specimen collected at Jackson, May 4, 1911, by Edward A. Preble.

Acer negundo Linnæus. Box Elder.

The box elder was noted chiefly along streams and in wet draws of the Great Plains area, but also at Bonanza in the Bighorn Basin, and between Dixon and Baggs along the southern boundary of the State.

Acer glabrum Torrey. Mountain Maple.

The handsome mountain maple inhabits cool slopes, gulches, and damp spots generally from the base of the mountains to 8,000 or 9,000 feet elevation, being most abundant in southeastern Wyoming. It was not noted in the Black Hills region, although found sparingly in cool north gulches at Squaw Butte, on the Wyoming-Nebraska line east of Kirtley. Its usual height is 5 or 6 feet in the mountains, and it rarely exceeds 8 feet even along streams.

Acer grandidentatum Nuttall. Large-Toothed Maple.

Scattered clumps of the large-toothed maple, 10 or 12 feet in height, are on the warm lower western slopes of the Salt River Range near Afton. The vertical range in these mountains is from their 6,300-foot bases up to 7,300 feet, in the Transition Zone, and it does not here attain its maximum growth. On the Salt River Range it is associated with the mountain maple, but does not occur as high as the latter.

Rhamnus alnifolia L'Heritier. Buckthorn.

The buckthorn reaches a short distance into Wyoming at the west, in the region contiguous to Snake River, but was not detected elsewhere. It is a conspicuous shrub on stream margins and in wet willow bottoms in the borders of Jackson Hole, and was abundant on Pacific Creek, 15 miles northeast of Moran. It was bearing its large ripe black berries in Webb Canyon in the Teton Mountains, at 6,700 feet elevation, September 1, 1910, and was collected by Alexander Wetmore on Trail Creek, near Teton Pass, late in September.

Ceanothus velutinus Douglas. Mountain Balm. (Fig. 14.)

Throughout the mountains one of the most characteristic shrubs is the mountain balm, in many places forming a dense chaparral 2 or 3 feet high on dry, open or partly forested slopes mainly in the Transition Zone. It was found in greatest abundance on dry summits of medium elevations, as the Bear Lodge, Casper, Shirley, Ferris, and Rattlesnake Mountains, on the 8,000-foot divide between the head of Salt River and Smiths Fork, and on Little Mountain, the elevated plateau between Maxon and the Green River Valley. The vertical limits are from 5,000 feet near Wolf, at the eastern base of the Bighorn Mountains, to 9,500 feet on Bridger Peak in the Sierra Madre. The white, sweet-scented flowers were conspicuous in Sierra Madre forests west of Grand Encampment between 8,500 and 9,500 feet, July 7, 1911, and the species was still in partial flower on the Wind River Range north of Big Sandy July 26, although past flowering near Fremont Lake on the same range by July 20.

Ceanothus fendleri Gray. Wild Tea Bush.

The low, much-branched wild tea bush is common on dry, warm slopes near Springhill, north of Laramie Peak. It was found in open yellow-pine forest up to 7,400 feet elevation, but was not noted elsewhere within the State.

Ceanothus mollissimus Torrey. Wild Tea Bush.

Vernon Bailey found this wild tea bush on Big Goose Creek, at the eastern base of the Bighorn Mountains. It is apparently rare in Wyoming.

Elæagnus argentea Pursh. Silverberry.

The silverberry occurs across Wyoming at the west, where it forms a scattering silvery fringe on stream banks mainly in the Transition Zone. It is especially abundant on streams of the upper Green River Basin and on tributaries of Wind and Snake Rivers. Elsewhere it was observed at Maxon, Lonetree, Cokeville, Meeteetse, on the South Fork of the Shoshone River, Pat O'Hara Creek, and on Gardiner River, near Mammoth Hot Springs.

Lepargyrea argentea (Nuttall) Greene. Buffaloberry.

While abundant locally on many streams at the base of the mountains, especially at the north, the buffaloberry is by no means generally distributed over the State, and was not detected in the southwest. The localities where it was found are mainly Upper Sonoran: Sibylee Creek, Casper, Belle Fourche River, Little Missouri River, Powder River, Clear Creek, streams near Sheridan and Ranchester, up Wolf Creek to 4,500 feet elevation, Alcova, Casper Creek, north slope Rattlesnake Mountains, Snake River at Baggs, Wind River Basin (mainly below 6,000 feet), and streams of Bighorn Basin.

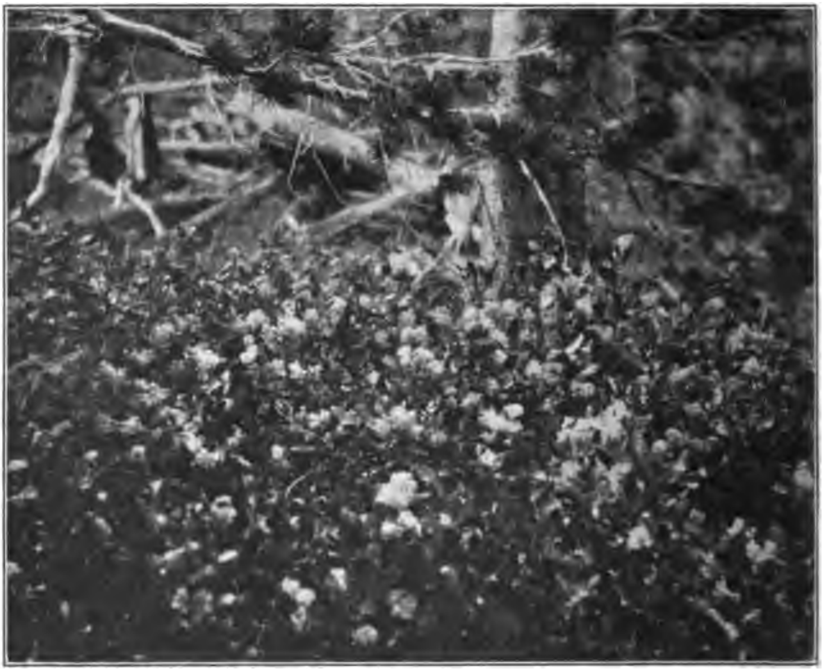

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FIG. 14.—Mountain balm (*Ceanothus velutinus*) in flower, Sierra Madre, July 7, 1911 (9,000 feet).

Lepargyrea canadensis (Linnæus) Green. Canadian Buffaloberry. (Fig. 15.)

The Canadian buffaloberry is a characteristic and widely distributed undershrub in the forests of the Canadian Zone between 8,000 and 10,000 feet elevation. Although usually found on mountain slopes, it is abundant in balsam poplar growth along Snake River and other streams of Jackson Hole.

Phyllodoce empetriformis (Smith) Don. Mountain Heath.

The mountain heath, a characteristic evergreen of the Hudsonian Zone, was found locally abundant at widely separated localities in the high ranges of northwestern Wyoming. Near Fremont Peak it was abundant in bogs and rocky situations from 10,500 feet altitude to a little above timberline, and occasional at 10,000 feet. On July 20 the dainty rose-colored flowers were still open on the Wind River Mountains, but on August 1 it was nearly through flowering on Whirlwind Peak, in the Absaroka Range. At timberline on the Tetons no flowers remained on the branches by August 30.

Menziesia ferruginea Smith. Rustyleaf.

This handsome and conspicuous shrub was observed only in the dense coniferous forests of Yellowstone Park, where it is common near Sylvan Pass, Lone Star Geyser, below Norris Basin, Thumb, Lewis River, and Snake River near Soldier Station.

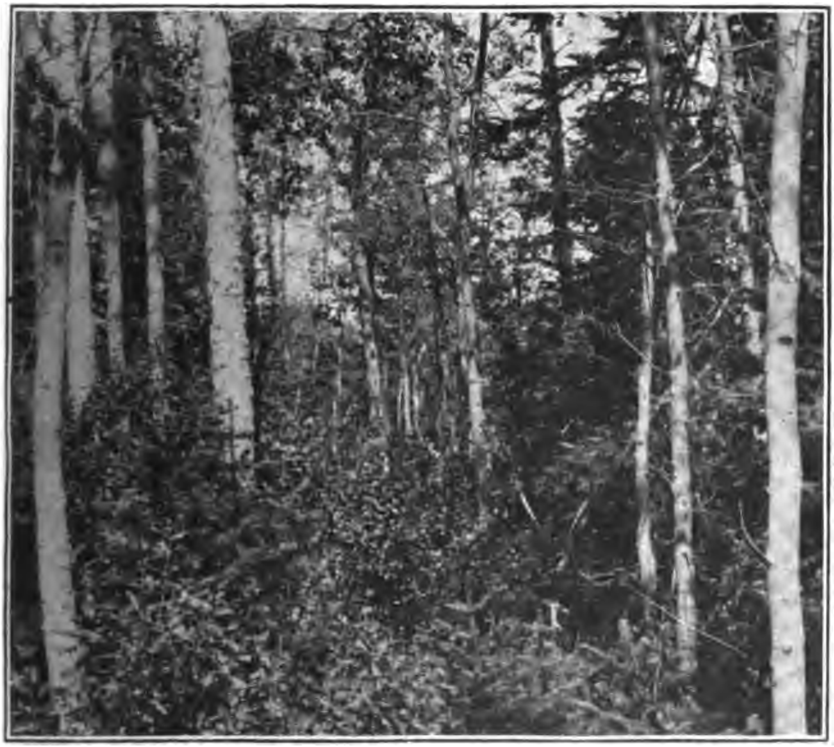

FIG. 15.—Canadian buffaloberry (*Lepargyrea canadensis*) in aspen woods, Wyoming Range near Merna (8,000 feet).

Kalmia polifolia Wangenheim. Laurel.

The wet bogs and mossy margins of the numerous snow-fed lakes on the Wind River Range south of Fremont Peak were bright with pretty pink-purple flowering mats of laurel in mid-July, 1911. The species was in flower on July 18 in the Hudsonian Zone from 10,000 to 11,000 feet elevation, but was not detected above timberline. With *Phyllodoce empetriformis* it often formed dense mats, from a few inches to nearly a foot in height. Vernon Bailey collected the laurel in the timberline region on the Wind River Mountains above Bull Lake in 1893, and at the head of Raven Creek, in Yellowstone Park, in 1915.

Arctostaphylos uva-ursi (Linnaeus) Sprengel. Red Bearberry.

The low trailing red bearberry, with its leathery evergreen leaves, dainty rose-hued blossoms, and red berries, forms beautiful mats in the open yellow pine forests of the Black Hills, Laramie Peak region, and on the eastern slopes of the Bighorn Mountains. While most abundant in the Transition Zone, it occurs occasionally in the coniferous forests higher up, as on the upper slopes of Laramie Peak and on the Wind River Range south of Dubois. It is very abundant in the woodlands of Jackson Hole, and also on the Bear Lodge Mountains; at from 5,000 to 8,000 feet elevation on the eastern slope of the Bighorn Mountains near Wolf; and from 8,000 to 9,500 feet on their western slope above Hyattville; on the Rattlesnake, Shirley, and Green Mountains; south of Fremont Peak and on the head of the Big Sandy, Wind River Range: Needle Mountain and Grinnell Creek, Absaroka Range; Merna; Evanston; and north slopes of Uinta Mountains west of Lonetree.

Vaccinium oreophilum Rydberg. Mountain Blueberry.

The mountain blueberry reaches perfection of growth in the cool, damp forests of the Canadian Zone at about 8,000 feet elevation. In many localities it occurs with *Vaccinium erythrococcum*, but it is less abundant and usually not found so high up. It was observed on the Bear Lodge, Shirley, Casper, Ferris, and Bighorn Mountains; Grinnell Creek, Absaroka Range; forests of Yellowstone Park; Teton Pass and Moose Creek, Teton Range; wooded hills bordering Jackson Lake; head of Pacific Creek; Snake River west of Jackson; Salt River Range near Afton; and on the Wyoming Range near Merna.

Vaccinium erythrococcum Rydberg. Red Bilberry. (Pl. IX, fig. 2.)

The low, small-leaved red bilberry was noted on all the higher elevations of Wyoming. It is most abundant in the upper Canadian Zone, where it densely carpets the coniferous forest floor, and it is the only *Vaccinium* present in the Hudsonian belt of dwarfed forest higher up. In early August the small juicy red berries are greatly relished by dusky grouse and other forest birds.

Vaccinium occidentale Gray. Western Blueberry.

The shrubby western blueberry was encountered in northwestern Wyoming, from Lewis Lake, Yellowstone Park, south to Jackson Lake, and east on the Wind River Range to Fremont Peak. It attains a height of nearly 2 feet in Yellowstone Park, growing in dense clumps in lodgepole pine forests between 7,000 and 8,000 feet elevation. Its small blue berries were ripe south of Lewis Lake on August 18, 1910. South of Fremont Peak it was growing in bogs a little below timberline, at 10,500 feet.

Fraxinus lanceolata Borckhausen. Green Ash.

The green ash occurs sparingly in the low stream valleys of extreme eastern and northern Wyoming west to the base of the Bighorn Mountains. It was found at Newcastle; Sand Creek to 10 miles above Beulah; Hay Creek to Aladdin and Eothen; groves on the Belle Fourche flats at Devils Tower; Little Missouri River; gulches near Morse; Powder River near Montana boundary; Prairie-dog Creek; Sheridan; Big Goose Creek; Wolf Creek, to 4,500 feet elevation, near Eaton's Ranch.

Sambucus microbotrys Rydberg. Red Elderberry. (Fig. 16.)

The red elderberry is a characteristic shrub of the Canadian Zone coniferous forest on the main ranges of Wyoming. Usually it is the only elderberry present on the higher slopes, but lower down occurs with its black-fruited relative, *Sambucus melanocarpa.* The red elder was not taken in the foothill ranges of eastern Wyoming nor in the Bighorn Mountains, but it has a general distribution from 7,000 to 9,500 feet elevation in the mountains farther west.

Sambucus melanocarpa Gray. Black Elderberry.

The black elderberry is of lower vertical range than the red species, occurring mainly in the Transition Zone, and from our observations was not so generally distributed. It was noted on Laramie Peak, north slope, rare at 8,000 feet elevation; Shirley Mountains, north escarpment, 7,600 feet to summit; Ferris Mountains, in dense coniferous forest, 8,000 to 9,000 feet; Salt River Range, 7,000 feet. Vernon Bailey found it bearing ripe berries on August 10, at 7,500 feet, on a southwest slope in the Bighorn Mountains near Wolf.

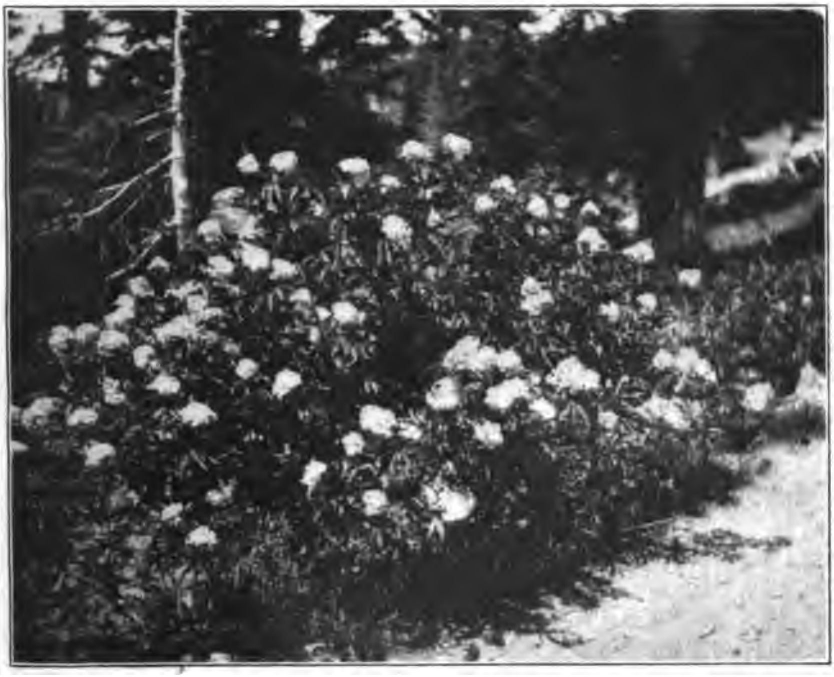

Fig. 16.—Red elderberry (*Sambucus microbotrys*) in bloom, Sierra Madre, July 7, 1911 (10,000 feet).

Sambucus canadensis Linnæus. Elderberry.

The large elderberry, *Sambucus canadensis*, was detected only at the southern base of the Bear Lodge Mountains near Sundance, in the Transition Zone. Its handsome flat-topped cymes of white flowers were very conspicuous in the canyon along Sundance Creek, at 4,700 feet elevation, on June 20, 1912.

Viburnum lentago Linnæus. Sweet Viburnum.

Vernon Bailey found the sweet viburnum not uncommon in August, 1913, in the shaded canyons and gulches along Sand Creek above Beulah, at the northern base of the Black Hills. He also reports it from the Belle Fourche Valley near Devils Tower, and along Big Goose Creek at the east base of the Bighorn Mountains.

Symphoricarpos occidentalis Hooker. Wolfberry.

The wolfberry occurs over much of the Upper Sonoran Great Plains area, forming dense thickets 2 feet in height in gulches and along streams, and in many localities constituting the principal shrubby growth. The species regularly extends west to the bases of the Laramie and Bighorn Mountains, and was found also in Wind River Basin, and at the eastern base of the Absaroka Range northwest of Cody.

Symphoricarpos pauciflorus (Robbins) Britton. Few-Flowered Snowberry.

The few-flowered snowberry is higher ranging than the wolfberry (*Symphoricarpos occidentalis*) and occurs mainly in the Transition Zone in northern Wyoming. It was recorded at various altitudes from 4,700 feet to 8,500 feet in the Bear Lodge, Bighorn, Absaroka, and Wyoming Ranges.

Symphoricarpos oreophilus Gray. Mountain Snowberry.

The mountain snowberry is the predominating species of its genus in Wyoming, where it is rarely absent from dry, rocky, open, or partly forested slopes and ridges in the Transition Zone. On some of the southern and western ranges it is common on exposed points in dry forest openings up to 9,000 feet elevation. This shrub enters the lower portions of Yellowstone Park at the north and south, and occurs in the open sections of Jackson Hole.

Symphoricarpos rotundifolius Gray. Round-Leaved Snowberry.

The round-leaved snowberry is apparently uncommon. It is represented by a specimen from Rawhide Butte, taken July 23, 1909, where scattering bushes were noted from base to summit in the Transition Zone.

Lonicera glaucescens Rydberg. Douglas Honeysuckle.

The Douglas honeysuckle reaches Wyoming in the extreme northeast, where it is found sparingly along streams and on damp slopes above 4,700 feet elevation near Sundance, in the Bear Lodge Mountains.

Lonicera utahensis Watson. Utah Honeysuckle.

The Utah honeysuckle abounds in the mountain forests of extreme western and northwestern Wyoming. From the forests of Yellowstone Park, where it is especially abundant, it occurs south at least to the Salt River Mountains, reaching its upper limits on the western slope of this range at 9,000 feet elevation, and on the eastern slope of the Teton Range at about 8,000 feet.

Lonicera involucrata Banks. Involucred Fly Honeysuckle.

In Wyoming the involucred fly honeysuckle occurs commonly in all the principal ranges with the possible exception of the Bighorn Mountains. It becomes increasingly abundant westward, and is one of the most characteristic shrubs on the banks of cold streams up to 8,000 or 9,000 feet elevation in the Canadian forest belt, ripening its blackish berries about the first of August.

Chrysothamnus graveolens (Nuttall) Greene. Rabbit Brush.

The plains, deserts, and basal mountain slopes of Wyoming are rich in species of *Chrysothamnus*, some of them among the best characterizing shrubs of the Upper Sonoran or Transition Zones. The meager data secured by Survey parties relates mainly to species which are of importance in determining life zones. *C. graveolens* is a conspicuous shrub, often several feet high, growing in Upper Sonoran gulches, desert arroyos, and on dry slopes, principally in eastern and northern Wyoming. It is especially abundant on flats along Bighorn River in the lower portions of the Bighorn Basin. The species occurs at Cassa; Fort Fetterman; Casper; along the North Platte near Alcova; Hay Creek east of

Aladdin; Wind Creek northeast of Moorcroft; Buffalo; gulches at south base of Owl Creek Mountains; Badwater River north of Shoshoni; Worland; Manderson; Greybull; Frannie to Garland; and east of Cody.

Chrysothamnus linifolius Greene. Rabbit Brush.

Like *Chrysothamnus graveolens*, this species is a fair-sized shrub, inhabiting principally the cut banks of adobe along desert washes and streams in the Upper Sonoran Zone, as along Bear Creek, south of Cassa; Rock Springs; and warm pockets along Green River between Fontenelle and Labarge. Vernon Bailey collected a specimen at Arvada, on Powder River, August 13, 1913. Nelson found the species at Point of Rocks and Granger.[1]

Chrysothamnus plattensis Greene. Rabbit Brush.

Chrysothamnus plattensis is a low, spreading Upper Sonoran species of rabbit brush of the North Platte and tributary valleys at the southeast. It was noted up to 6,200 feet elevation on Horse Creek, near Meadow, and also at Snow's Ranch, on Rawhide Creek below Patrick.

Chrysothamnus stenophyllus Greene. Rabbit Brush.

This is a common species of rabbit brush over most of the sandy plains and ridges of central Wyoming, in the Upper Sonoran Zone, as at Casper, Efell, and in Sweetwater Valley from Independence to Splitrock. Nelson records it from Point of Rocks, on the Red Desert.[1]

Chrysothamnus stenophyllus Greene. Rabbit Brush.

This species was taken in the Upper Sonoran Zone in the Belle Fourche Valley at Moorcroft, August 15, 1913, by Vernon Bailey.

Chrysothamnus howardi (Parry) Greene. Rabbit Brush.

A specimen of *Chrysothamnus howardi* was collected by Vernon Bailey at Arvada, on Powder River, August 13, 1913. It is usually of the higher plains.

Chrysothamnus wyomingensis A. Nelson. Rabbit Brush.

Mainly of the high Transition plains and basal mountain slopes at the north. It is very abundant at the northern base of the Bighorn Mountains at Wolf, where a specimen was collected on June 6, 1912, and is apparently the species so abundant on the basal slopes of the Bear Lodge Mountains. Vernon Bailey collected it at Arvada, on Powder River.

Chrysothamnus pulcherrimus A. Nelson. Rabbit Brush.

This rabbit brush is common in the Transition Zone on the high central plains and in the upper Green River Basin, growing on open slopes with sagebrush regularly to 8,000 feet altitude. It is especially abundant on both slopes of the mountains near Laramie Peak, on the northern Laramie Plains, and in Shirley Basin. It was noted along Little Medicine Bow River west of Marshall at 7,000 feet.

Artemisia tridentata Nuttall. Black Sagebrush. (Fig. 17.)

The most widely distributed shrub in Wyoming is the black sagebrush. It is omnipresent in open country east to the edge of the Great Plains, where its eastern limits are marked by Orin Junction (North Platte Valley), Lost Spring, Indian Creek north of Kirtley at State line, Clifton, Newcastle, Wind Creek northeast of Moorcroft, and Colony. It was not found east of the Laramie Mountains in southeast Wyoming. From 4,000 feet elevation at the east this sagebrush extends to timberline on some of the ranges, attaining 9,800 feet on the Bighorns above Hyattville, and 10,000 feet on the Wind Rivers south of Dubois and on the Wyoming Range west of Bigpiney and Merna.

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[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 66, 1898.

Artemisia cana Pursh. Gray Sagebrush.

The gray sagebrush is generally dispersed and especially common in the mountain valleys and parks, but less abundant than the black species. It extends into the edge of the Great Plains area. In the valleys east of the Laramie Mountains this is usually the only shrubby sage present, and it forms much of the scattering growth on the open stretches between the Black Hills and Bighorn Mountains. Westward it rapidly gives way to the black sagebrush.

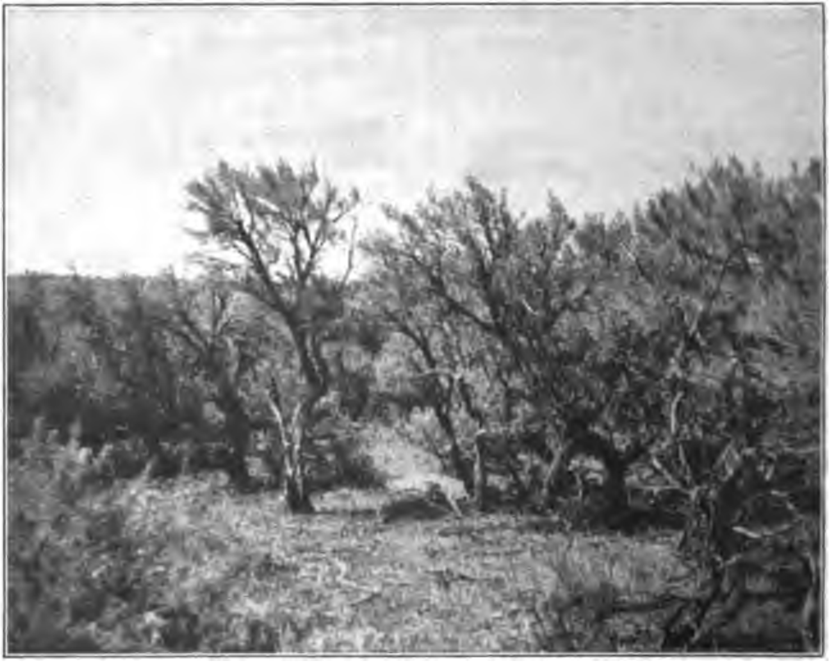

FIG. 17.—Black sagebrush (*Artemisia tridentata*) 10 feet high, upper Wind River Valley.

Artemisia trifida Nuttall. Sagebrush.

A small shrubby sage, sparingly present in open Transition country chiefly at the west, as on the summit of the Owl Creek Mountains; Bear River Divide north of Evanston, 7,500 feet elevation; benches above Cokeville; and Salt River Valley. Vernon Bailey found the species in open parks in the mountains south of Douglas, near Valley, and in Jackson Hole.

Artemisia filifolia Torrey. Narrow-Leaved Sagebrush.

The narrow-leaved sagebrush is a characteristic shrub of the Great Plains Sonoran area, occurring in the North Platte drainage chiefly in sandy tracts as far west as Guernsey. A very dense growth 2 or 3 feet high covers the Rawhide flats at Snow's Ranch south of Patrick, and it is abundant in the sandy valley of the Chugwater east of Wheatland.

Artemisia arbuscula Nuttall. Brown Sagebrush.

The brown sagebrush is uncommon, according to the author's observations. Vernon Bailey reports it at Hams Fork Station (Moyer Junction) and Valley, and collected specimens on the Owl Creek Mountains in 1893 and in Salt River Valley on August 15, 1911, all Transition Zone localities in western Wyoming.

Artemisia spinescens Eaton. Spiny Sage; Bud Brush.

A low spinescent shrubby sage, abundant at many localities in the Upper Sonoran desert region at the southwest. It is common, also, on sandy benches near Shoshoni and in the lower parts of the Bighorn Valley near Greybull and Manderson. It occurs at many stations with the less shrubby *Artemisia pedatifida*, with which it is sometimes confused.

Artemisia frigida Willdenow. Pasture Sage.

The pasture sage, a low silvery sage, is scarcely a shrub, but is included as a characteristic Transition species of the genus. It has a very wide range over Wyoming on high plains, bare ridges and plateaus, and open mountain slopes generally.

Tetradymia spinosa Hooker and Arnott. Spiny Rabbit Brush.

The members of the genus *Tetradymia* are characteristic shrubs of the Great Basin Division of the Upper Sonoran Zone, and do not enter the Great Plains area. They occur in varying abundance and scattered bunchlike growths over the dry hills and plains of the arid central desert section, from the Green River Valley and Red Desert north to the Bighorn Basin.

Tetradymia spinosa is the more widely distributed species below 6,500 feet altitude. It is common at Green River, Superior, Rock Springs region, warm river flats (Fontenelle to Labarge), sand flats north of Opal, Shoshoni, Worland, Bonanza, Manderson, Greybull to Cody, and Frannie to Garland.

Tetradymia nuttalli Torrey and Gray. Nuttall Rabbit Brush.

The Nuttall rabbit brush is more spiny than the preceding species. It was collected only at Fort Steele, where it was abundant in the warm, lower parts of the North Platte Valley. Nelson mentions specimens from Bitter Creek and Green River.[1]

Tetradymia inermis Nuttall. Rabbit Brush. (Pl. VII, fig. 2.)

This high-ranging rabbit brush grows abundantly on the sandy plains of the upper Green River Basin to an elevation of 7,500 feet. It was not found at the lower levels, but was common on sand flats at Eden and Big Sandy and also on Little Piney Creek. Nelson collected specimens at Bitter Creek on the Red Desert.[1]

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[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 67, 1898.

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BUREAU OF BIOLOGICAL SURVEY
E. W. NELSON, *Chief*

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THE RICE RATS OF NORTH AMERICA

(Genus ORYZOMYS)

BY

EDWARD A. GOLDMAN
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
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1918

LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., April 26, 1917.

Sir: I have the honor to transmit for publication as North American Fauna No. 43 the results of a study of North American forms of the rice rats (genus *Oryzomys*), by Edward A. Goldman, assistant biologist of this bureau. This constitutes a revision of this group, based chiefly upon material in the collection of the Biological Survey. Rice rats are distributed from the latitude of Maryland and Delaware south through parts of the Southeastern States, Mexico, and Central America to South America, where they reach their highest development. While not so injurious to agriculture as some other rodents, they consume in the aggregate large quantities of forage when, like cottonrats and meadow mice, they increase locally to excessive numbers. A knowledge of their distribution, as presented in this report and its accompanying maps, will aid in studies made to control the depredations of rice rats. Owing to their nocturnal habits the animals are little known, and their economic relations should be better understood.

Respectfully,

E. W. Nelson,
Chief, Biological Survey.

Hon. D. F. Houston,
Secretary of Agriculture.

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No. 43. NORTH AMERICAN FAUNA. Sept. 23, 1918.

THE RICE RATS OF NORTH AMERICA.

(Genus ORYZOMYS.)

By EDWARD A. GOLDMAN.

INTRODUCTION.

The rice rats of the genus *Oryzomys* belong to the murine subfamily Cricetinæ, which includes also a number of closely allied generic groups of American rodents, as the vesper rats (*Nyctomys*), deer mice (*Peromyscus*), grasshopper mice (*Onychomys*), and others. By reason of their small size and nocturnal habits all these rodents largely escape observation, and the economic importance resulting from their excessive numbers and wide distribution is not generally realized. The vernacular name "rice meadow-mouse," bestowed on *Oryzomys palustris* by Bachman, because originally it was found in the rice fields of South Carolina and Georgia, has led to the appellation "rice rat" commonly applied to all species of the genus, although many inhabit regions where rice is not cultivated.

Owing to similarity in ratlike form and general appearance, most of the genera with which *Oryzomys* is allied, including species with widely differing habits, are scarcely recognizable by external characters alone, and reliance must be placed on distinguishing features exhibited by skulls and teeth. The genus *Oryzomys* comprises a somewhat composite assemblage of species presenting considerable diversity in general characters, but having the essential dental arrangement repeated with remarkable fidelity throughout the series.

The general range of the genus is from New Jersey and the central part of the Mississippi Valley southward, the group being represented in nearly every part of South America and apparently reaching its greatest development there. More than 150 species and subspecies have been described, of which number, however, some have been segregated in the erection of closely allied genera, and others are doubtfully allocated. Many regions remain unexplored and the number of forms assignable to *Oryzomys* as now restricted will probably far outnumber those of any other genus of American rodents. In the present revision are treated the North American continental species as far as the eastern border of Panama, and those of outlying islands. Fifty-one forms of 21 species are recognized, two of which are characterized for the first time. These are comprised in the three subgenera *Oryzomys*, *Oligoryzomys*, and *Melanomys*.

HABITS AND ECONOMIC RELATIONS.

The habits of all the rice rats are somewhat similar, but differ in details in conformity with varying environmental conditions. In general, a preference is shown for meadows or marshy areas, commonly in the vicinity of water at rather low elevations; but some species have ascended, especially along the courses of streams, to high altitudes; others, departing farther from the semiaquatic environment, have entered the forest and become partially scansorial. They are nocturnal and, like many other small rodents, thus escape ordinary observation, most species coming out and wandering here and there through marsh, meadow, and herbaceous or even shrubby vegetation. Fairly well-worn runways are sometimes made along the edges of water or form general routes through dense vegetation, but these are not so well defined as those of the cotton rats (*Sigmodon*), which often share the same local habitat. The more aquatic species readily enter the water and swim and dive freely.

The nests, made of plant fibers of many kinds, are placed in shallow burrows or sheltered places, commonly under massed vegetation on or near the ground, but the site chosen may be in a tangled clump of flags or marsh grasses standing in the water. From 3 to 7 young are produced at a birth, 4 or 5 being the usual number. In *Oryzomys palustris* many young are brought forth in the months of April and May, but in this and other species their appearance at all seasons is ample evidence that there is no definite breeding season, except possibly near the extreme northern limit of the group.

The rice rats feed extensively on green or succulent plants, food habits shared with the cottonrats (*Sigmodon*) and meadow mice (*Microtus*). In early morning many freshly cut grass stems in the meadows evidence their nocturnal activity in favored places. While green food forms the normal ration of most species, drier foods, as seeds, also are eaten to some extent, and as with some other small rodents meat is relished at times. Specimens may be taken in meat-baited traps, and individuals thus caught are sometimes devoured by their own kind. Bachman,[1] who studied the habits of *Oryzomys palustris*, records that those kept in captivity "fed on grains of various kinds, but always gave the preference to small pieces of meat." In their natural habitat he observed them scratching up the recently planted rice. He found that they begin feeding on rice when it is in the milky state and continue gathering the scattered grains in the fields during autumn and winter. He also observed them feeding on the large seeds of the gama grass (*Tripsacum dactyloides*), on those of the wild rye (*Elymus virginicus*), and at certain seasons on those of the marsh grass (*Spartina glabra*). Bachman further states that the rice rat "sometimes retires to the shore for food, but has no disrelish to the small crustacea and mollusks that remain on the mud at the subsiding of the tide."

---

[1] Audubon, J. J., and Bachman, John, Quadr. North Amer., III, p. 215, 1854.

Species inhabiting forested areas usually become very abundant in clearings where a ground cover is allowed to grow. Rice rats apparently are not so injurious to crops as some other rodents, but like the cotton rats and meadow mice increase locally to excessive numbers and then consume, in the aggregate, very large quantities of forage. Methods of poisoning that have proved effective in checking the ravages of meadow mice could probably be utilized with similar success in the control of rice rats. Owing to their nocturnal habits these mice are preyed upon by owls and doubtless by many carnivorous mammals. The rice rats and allied members of the great murine family to which they belong are the most numerous of American mammals, and their economic relations should be better known.

GENERAL CHARACTERS.

The rice rats as a whole present a wide range of variation in external appearance. Some of the larger, more robust species, including *Oryzomys palustris*, have not infrequently been mistaken for Old World rats of the genus *Rattus*, which have followed civilized man in his migrations and now not only universally infest his structures, but in favorable districts invade the fields in close competition with native rodents. Superficial resemblances are often striking, the bodily proportions and color and texture of pelage being very similar. On the other hand, many species are widely different from the Old World rats, in rich tawny coloration or character of pelage, and are more likely to be confused with allied American murine genera. The smallest North American species (subgenus *Oligoryzomys*) simulate in color, delicate structure, and great length of tail some of the harvest mice (*Reithrodontomys*); another group (subgenus *Melanomys*) is more robust, the tail very short, and general proportions *Akodon*-like.

In *Oryzomys* and allied genera superficial resemblances frequently mask the more essential features, and external characters, especially size and color, are less dependable than cranial modifications in tracing relationships of species. The group alignment, however, is often indicated by proportions of body and limbs; color and length of general pelage; length of vibrissæ; hairiness of ears, feet, and tail;

presence or absence of prominent tufts of digital bristles; and form of claws. Aside from the general form and angularity of the skull, the principal characters of taxonomic value are the following: Size and form of incisors and molars; depth and arrangement of reentrant angles, form and position of enamel islands, and development of cusps in molar crowns; length and form of anterior palatine foramina; length of palatal bridge; position of lachrymals; form of maxillæ, premaxillæ, frontals, parietals, and interparietal; and size and form of audital bullæ.

PELAGE.

The pelage is rather harsh in texture throughout the genus, but varies greatly in length in the component groups. The overfur is longer, the vibrissæ shorter, and the underfur denser and more woolly in semiaquatic species. Groups in which the pelage is normally short tend to develop longer fur in the forms which range at high altitudes; but several species, some with pelage much longer than others, may occur together at the same elevations. The ears are rather small and in typical *Oryzomys* and various groups, including the subgenus *Oligoryzomys*, the hairy covering is moderately long, coarse, and not sharply differentiated from the body fur; in the *O. talamancæ* and other groups the ears are minutely pilose, in marked contrast with the general pelage. The claws on the toes of the hind feet in the semiaquatic or more strictly terrestrial species are relatively long and straight, broad, and obtuse, and only partially overlapped by the digital bristles, while in the less aquatic or scansorial species they are short and recurved, compressed and sharp pointed, and prominent digital tufts project beyond the ends. In *O. palustris* the vibrissæ scarcely reach from the muzzle to the ears; in *O. pirrensis* and *O. bombycinus* they extend over the shoulders, while in various species they are intermediate in length.

COLOR.

In coloration of upperparts the range of variation in the rice rats is from pale shades of buff or gray to rich tawny or russet, more or less mixed with black, especially over the median part of the dorsum. The underparts usually are dull white or buff, without a sharp line of demarcation along the sides, the plumbeous basal color showing through (a few species exhibiting basally white areas). The tail is not very sharply bicolor, but usually is brown above and lighter below, at least basally, the epidermis and scanty investing hairs of about the same tone.

MOLT.

As breeding begins during adolescence and is continuous throughout the year, and as individuals arrive at maturity at all seasons, there is no very definite period for molting, although the more northerly forms tend in winter to acquire a longer pelage, which becomes abraded in summer. As a rule the new coat seems to replace the old almost imperceptibly, but adults in apparently fresh and in obviously worn pelages may often be seen together.

AGE.

The age of individuals is indicated approximately by the degree of wear on the molar crowns. The shearing of the slopes, beginning early in life, becomes distinctly noticeable as full growth is attained, and, progressing rapidly across the summits of the tubercles, in advanced age results in the obliteration of all trace of enamel arrangement.

VARIATION.

Variation in the rice rats is assignable to several categories, of which perhaps the most obvious are individual and geographic.

INDIVIDUAL VARIATION.

By individual variation is meant all the degrees of divergence from a typical mean exhibited by large series of conspecific skins and skulls from any given locality. The range of this variation, especially in general size, is extraordinary; in many species of corresponding age and sex it exceeds 10 per cent both in external and cranial dimensions. The typical mean, therefore, may be difficult to determine when a small series of examples exhibits preponderance toward either of the extrémes; and conclusions based on the dimensions of a small number of individuals are likely to be misleading. While males average slightly larger than females, sexual differences in size appear to be negligible. Cranial variations in proportions and in the form of individual bones are noticeable, but usually within rather circumscribed limits. Some skulls are decidedly broader and more massive than others of the same age and sex. Thickness of rostrum is usually, but not always, associated with breadth of frontal region and braincase. General expansion of the braincase commonly results in increased breadth across the posterior part of the frontals. The interparietal is variable in form, as are the parietals in the extent of encroachment of the lateral wings on the squamosals. The size of the molar teeth and of the audital bullæ is fairly constant.

Individual variation in color is much less than in size. Much of the variation in color observable is due to age or condition of pelage. The older adults tend at all seasons to exhibit more rufescent tones than the younger. A rusty reddish appearance is often due to much-worn pelage. There are no distinct color phases.

GEOGRAPHIC VARIATION.

Geographic variation, or the tendency of species to subdivide into regional or more or less localized forms, is very great in the genus *Oryzomys*. Of the numerous forms first described as distinct species a considerable number prove when better known to be geographic representatives of widely ranging specific types, presenting differential characters associated in part with environmental conditions. The intergradation and subspecific position of many such forms can be demonstrated beyond any reasonable doubt in some instances, and in others may be safely assumed, in the light of knowledge of the essential characters of the particular group. Since the distribution of the rice rats is mainly at low elevations, it is not surprising to find that species maintaining the same characters over extensive areas near sea level, where nearly uniform topographic and climatic conditions prevail, become locally modified on ascending to high altitudes. Thus, *O. couesi* and *O. alfaroi* are represented by widely ranging coastal forms and by more localized high-mountain races. That forms inhabiting mainly open, arid regions are paler than those inhabiting humid or heavily forested areas is well illustrated by the distribution of the races of *O. couesi* in Mexico. The dark typical form occupies the relatively humid area near the Gulf of Mexico and the Caribbean Sea, while the pale subspecies, *O. c. mexicanus*, pushes far northward along the arid Pacific coast, the point of divergence being near the Isthmus of Tehuantepec. Species reaching high altitudes tend to develop structural as well as color differences, while varying climatic conditions at low elevations are apt to result mainly in color modifications. Insular species are usually related to those inhabiting the adjacent mainland, but may exhibit very distinctive characters, unless the islands are very near the coast.

HISTORY AND MATERIAL.

A species of *Oryzomys* was first described under the name *Mus palustris* from New Jersey, by Richard Harlan,[1] in 1837. He compared the animal with the Norway rat, and owing to superficial resemblances regarded it as congeneric with the rats of the Old World. It was erroneously referred to the genus *Arvicola* in 1854 by Bachman,[2] who mentions having obtained specimens as early as the winter of 1816. According to Bachman, these specimens were described by him (but the description not published) in May, 1836. One was sent to the Academy of Natural Sciences of Philadelphia for comparison with material there, and on the basis of this and an example in the Academy collection Dr. Harlan felt authorized to publish his *Mus palustris*.

---

[1] Silliman's Amer. Journ. Sci., XXXI, p. 385, 1837.

[2] Audubon, J. J., and Bachman, John, Quadr. North Amer., III, p. 214, 1854.

In renaming the species *Arvicola oryzivora*, Bachman assumed that *Mus palustris* Harlan was preoccupied by *Arvicola palustris* Harlan,[1] an obvious error, as the two were not congeneric.

In 1857 Baird,[2] recognizing distinctive characters, used *Oryzomys* as a full generic name for the group, with *Mus palustris* Harlan as type, apparently inadvertently, however, as on a later page of his publication[3] he accorded it only subgeneric value under *Hesperomys* of Waterhouse. In this course he was followed by Coues in 1877.[4] Thirteen years later the same author[5] raised the name to generic rank. Meanwhile *Hesperomys fulvescens* Saussure[6] and *Hesperomys couesi* Alston[7] had been described, but their real generic position was not determined until later. New species were added at intervals, but of the relationships of the North American members of the genus little was known until 1901, when, as a result of study mainly of material which had accumulated in the collection of the Biological Survey, Merriam[8] published a synopsis of the forms inhabiting the United States and Mexico. Thirty-five species and subspecies were recognized by him, of which 20 were new. The species were divided into natural groups for the first time, and their salient characters pointed out. Short papers, largely descriptive of new species, by Thomas,[9] Allen,[10] Bangs,[11] Elliott,[12] and Goldman,[13] have since appeared. The larger collections now available render it possible to determine the status of nearly all names, and the relationship, especially of the more austral species, to South American forms.

The present revision is the result of a study of the rice rats in the Biological Survey, the Merriam, and other collections in the United States National Museum, now numbering 1,050 specimens, augmented by 563 from other American museums,[14] the assemblage including the types or topotypes of most of the species. The location of specimens examined in collections other than those in the United States National Museum is indicated by footnotes.

---

[1] Harlan, Richard, Fauna Americana, p. 136, 1825.

[2] Baird, S. F., Mamm. North Amer., p. 459, 1857.

[3] Op. cit., p. 482.

[4] Coues, Elliott, Monogr. North Amer. Rodentia, p. 113, 1877.

[5] Coues, Elliott, Century Dict., IV, p. 4165, 1890.

[6] Saussure, H. de, Rev. et Mag. de Zool., ser. 2, XII, p. 102, March, 1860.

[7] Alston, E. R., Proc. Zool. Soc., London, p. 756, 1876.

[8] Merriam, C. Hart., Proc. Washington Acad. Sci., III, pp. 273–295, July 26, 1901.

[9] Thomas, O., Ann. Mag. Nat. Hist., ser. 7, VIII, pp. 251–253, Sept., 1901.

[10] Allen, J. A., Bull. Amer. Mus. Nat. Hist., XXIV, pp. 654–657, Oct. 13, 1908 (including *Oryzomys ochraceus* [= *Nectomys alfari*], see Goldman, Proc. Biol. Soc., Washington, XXIX, p. 127, June 6, 1916); ibid., XXXIII, pp. 99–100, Apr. 30, 1910; ibid., XXXII, pp. 533–554, Nov. 17, 1913.

[11] Bangs, O., Bull. Mus. Comp. Zool., XXXIX, pp. 33–36, Apr. 1902.

[12] Elliott, D. G., Field Columb. Mus. publ. 71, Zool. ser. III, p. 145, Feb., 1903; ibid., III, pp. 266–267, Mar. 1904.

[13] Goldman, E. A., Smiths. Misc. Coll., LVI, no. 36, pp. 5–8, Feb. 19, 1912; ibid., LX., no. 22, pp. 5–6, Feb. 28, 1913; Proc. Biol. Soc. Washington, XXVIII, pp. 127–130, June 29, 1915.

[14] For the use of material generously loaned and for other courtesies the author's thanks are due to Dr. J. A. Allen, American Museum of Natural History; to Mr. Samuel Henshaw and Mr. Outram Bangs, Museum of Comparative Zoology; to Mr. W. H. Osgood, Field Museum of Natural History; to Mr. Witmer Stone, Academy of Natural Sciences of Philadelphia; to Mr. W. E. Clyde Todd and Mr. O. P. Murie, Carnegie Museum; and to Mr. C. D. Bunker, Kansas University Museum. In addition he is indebted to Mr. Oldfield Thomas for critical notes and comparisons of specimens with types in the British Museum.

EXPLANATIONS.

MEASUREMENTS.

All measurements of specimens are in millimeters. With a few exceptions, usually stated, the external measurements were taken in the flesh by the collector, as follows: *Total length,* nose to end of terminal tail vertebra; *tail vertebræ,* upper base of tail to end of terminal tail vertebra; *hind foot,* heel to end of longest claw. While adult males average slightly larger than females, the difference is scarcely appreciable and in the small series usually available may be ignored. The external and cranial measurements given, therefore, are of series which may include specimens of both sexes. Of many species and subspecies so few nearly typical examples are available that the measurements given may not represent the normal range of individual variation, and too broad generalizations, therefore, should not be based upon them. The following cranial measurements were taken with a vernier caliper by the author:

Greatest length.—Length from tip of nasals to supraoccipital in median line over foramen magnum.

Zygomatic breadth.—Greatest distance across zygomata.

Interorbital breadth.—Least distance between orbits.

Width of braincase.—Distance between outer sides of squamosals at the slight constriction over auditory meatus and immediately in front of lateral occipital crests.

Nasals.—Greatest length of nasals.

Anterior palatine foramina.—Greatest length of large palatal foramina.

Palatal bridge.—Distance from excavated posterior border of palate to posterior end of either large palatal foramen.

Upper molar series.—Greatest length of maxillary toothrow at alveolar border.

COLORS.

The names of colors used in descriptions are mainly those of Ridgway.[1] A few other modifying or comparative terms, however, have been employed, usually when some special difficulty was encountered in naming an indefinite hue or tone.

TEETH.

The nomenclature of the principal tooth elements used in the text is given in figure 1.[2]

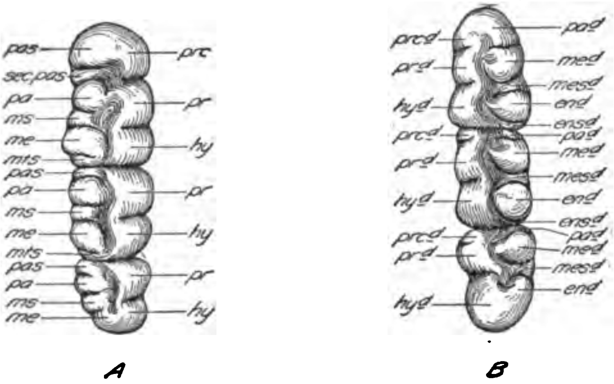
---

[1] Ridgway, Robert, Color Standards and Color Nomenclature, 1912.

[2] For the homology and nomenclature of the molar crown divisions the writer is indebted to Messrs. Gerrit S. Miller, jr., and James W. Gidley, whose extensive researches, still in progress, in the phylogeny of the rodents, enable them to render an authoritative opinion.

ZONAL DIVISIONS.

Aside from the well-known extratropical North American zonal divisions, all references in the text under "Geographic distribution" are to less well-known tropical divisions, the Lower and Upper Tropical Zones, which may be roughly defined as follows: The Lower Tropical Zone, extending in tropical Middle America from sea level to elevations varying mainly in accordance with latitude and local topographic conditions. South of the twentieth parallel this zone reaches to about 3,000 or 3,500 feet altitude. Above these limits it is replaced by the Upper Tropical Zone, which extends to about 7,000 or 8,000 feet. Each of these zones is readily separable into subdivisions on the basis of moisture, and are denominated, respectively, the Humid and Arid Lower Tropical and the Humid and Arid Upper Tropical Zones.



pas.......Parastyle.
sec. pas....Secondary parastyle.
pa........Paracone.
ms........Mesostyle.
me........Metacone.
mts.......Metastyle.

prc........Protoconule.
pr........Protocone.
hy........Hypocone.

prc^{d}.......Protoconulid.
pr^{d}.......Protoconid.
hy^{d}.......Hypoconid.

pa^{d}.......Paraconid.
me^{d}.......Metaconid.
mes^{d}......Mesostylid.
en^{d}.......Entoconid.
ens^{d}.......Entostylid.

FIG. 1.—Molar teeth of typical *Oryzomys* with outlines accentuated to show principal crown elements. A, Right upper molars; B, left lower molars.

GENUS ORYZOMYS Baird.

Oryzomys Baird, Mamm. North Amer., pp. xlii, 458, 482, 1857 (subgenus of *Hesperomys* Waterhouse). Type *Mus palustris* Harlan.

Oryzomys Coues, Century Dict., IV, p. 4164, 1890.

Oligoryzomys Bangs, Proc. New England Zool. Club, I, p. 94, Feb. 23, 1900 (subgenus). Type *Oryzomys navus* Bangs.

Melanomys Thomas, Ann. Mag. Nat. Hist., ser. 7, X, p. 248, Sept. 1902 (subgenus). Type *Oryzomys phæopus* Thomas.

Melanomys Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 533, Nov. 17, 1913 (genus).

Geographic distribution.—Eastern and central United States from New Jersey, Kentucky, Illinois, Kansas, and Texas across Mexico to Lower California and south through South America to Cape Horn.

Generic characters.—Form murine; pelage slightly hispid, but not bristly or spiny; tail usually long, but varying from about three-fourths length of head and body to one-fourth longer, the annulated scales distinctly visible through short, sparse investing hairs; ears varying from small to rather large, and finely to coarsely haired; soles of hind feet naked to heels, normally 6-tuberculate; mammæ 8: pectoral, 2–2; inguinal, 2–2.

Skull relatively thin and smoothly rounded; supraorbital and temporal ridges prominent or obsolescent; interparietal variable in size and contour; zygomata slender, depressed to near level of molars; antorbital foramen subcylindrical above, more or less abruptly constricted to a narrow slitlike opening below; outer wall of antorbital foramen rather broad, but varying in extent of anterior projection, the upper border rounded or slightly angular; palate reaching posteriorly beyond plane of last molars, the interpterygoid border concave or presenting a slight median projection; palatal pits present; audital bullæ rather slightly inflated, tapering anteriorly and oblique in position.

Molar crowns low (slightly higher in *Melanomys* than in the other subgenera) with prominent cusps, cones, or tubercles, and well-developed styles, the principal cusps arranged nearly opposite in two longitudinal series; upper molars 3-rooted; lower molars 2-rooted. First upper molar with parastyle and paraconule strongly developed, partially divided near middle, and extended across internally for a distance equal to three-fourths or more of the greatest transverse diameter of tooth; secondary parastyle usually prominent; mesostyles and metastyles in all the upper molars present as small cusps or represented by enamel ridges connecting with principal inner cusps; inner cusps of first and second upper molars with oblique commissures; third upper molar with posterior portions more or less obsolete, the hypocone varying in development and the metacone usually indicated only by a low abbreviated enamel fold. Lower molar cusp-arrangement similar to upper, but paraconid and paraconulid in anterior tooth faintly or not at all notched longitudinally; protoconids and hypoconids in first and second molars with oblique commissures as in the homologous elements in upper teeth; mesostylids and entostylids joined by transverse enamel ridges with outer principal cusps; second lower molar with a moderately developed protoconulid; third lower molar with entoconid and entostylid completely fused or obsolescent. Front of upper incisors without grooves.

Remarks.—When the molars of *Oryzomys* are opposed the cusps in the upper jaw enter behind the corresponding cusps in the lower jaw. The parastyle is overlapped by the paraconid, the trenchant anterior border of which shears on its anterior surface. The paraconule of the anterior molar and the protocones and hypocones of the other molars are broadly beveled or sheared internally, as are the protoconids and hypoconids. The paracones and metacones, on the other hand, are at first sheared posteriorly, while the metaconids and entoconids are sheared anteriorly, but progressive wear extending across the summits tends to level the entire series uniformly.

The genus presents complex relationships to various murine genera. Among its nearer relatives is *Nectomys*, which the more typical forms much resemble in external appearance as well as in the general form of the cranium. In dentition the two genera are also similar, but in typical *Oryzomys*, while the molar crowns as a whole are decidedly lower, the cusps or cones are higher, more conical, with summits more fully covered with enamel. In *Nectomys*, on the other hand, the low cusps tend to fuse with the styles and dentine is exposed at an earlier age. *Oryzomys* differs from *Nectomys* in other dental details, especially the development of the paraconulid of the second lower molar. The subgenus *Melanomys*, however, exhibits a somewhat intermediate condition; the molar crowns as a whole are somewhat higher than in typical *Oryzomys*, and lower than in *Nectomys;* the cones are high as in *Oryzomys*, but in sculpture, especially the early exposure of dentine, approach those of *Nectomys*. Another character suggesting gradation of *Melanomys* toward *Nectomys* is the position of the lachrymal, its attachment being mainly with the maxilla as in that genus, instead of about equally with maxilla and frontal as in typical *Oryzomys*. Agreement with *Oryzomys* is shown in the more essential dental details, including the marked development of the paraconulid in the second lower molar, an element absent in *Nectomys*.

Comparison with various other genera reveals obvious resemblances and points of difference in varying combination. *Oryzomys* agrees closely with *Neacomys* in cranial and dental characters, but the latter genus exhibits a departure in its grooved and bristly or spiny pelage. The generic name *Nesoryzomys* based on rice rats inhabiting the Galapagos Islands does not seem well founded, as the palate and dentition are *Oryzomys*-like and in the short tail and reduced interorbital space, alleged generic characters, it is not widely different from some of the continental species of *Oryzomys*.

In dentition *Oryzomys* is similar to *Rhipidomys*, but the molar cusps are more crowded and the parastyle and protoconule are less distinctly separated by a median notch. The posterior part of the palate, however, presents features at variance in the two genera. Unlike that of *Oryzomys* the palate in *Rhipidomys* is excavated between the posterior molars, and the palatal pits are separated by the interpterygoid fossa. The genus *Nyctomys* is allied to *Rhipidomys*, but exhibits a wider departure from *Oryzomys*. The molar crown arrangement is similar in all three genera, but in *Nyctomys* the cusps are more angular, the styles and commissures less developed, and the enamel covering maintained until later in life than in the others. In the posterior excavation of the palate *Nyctomys* more nearly resembles *Rhipidomys;* but, in the remarkable lateral development of the interparietal to a broad line of contact with the squamosals and consequent isolation of supraoccipital and parietals, *Nyctomys* differs notably from both *Rhipidomys* and *Oryzomys*.

Some sections of the large genus *Peromyscus* are not very widely different from *Oryzomys* in dentition, but the principal cusps are obliquely placed, the protoconule much more developed, and the paracone and metacone shear mainly internally instead of posteriorly as in *Oryzomys*. The general form of the skull in *Peromyscus* is distinctive; the palate ends near the posterior plane of the molars and the palatal pits present in *Oryzomys* are absent.

In external appearance the genus *Reithrodontomys* bears a remarkable resemblance to the oryzomine subgenus *Oligoryzomys;* and in the *Aporodon* section of *Reithrodontomys*, in which the styles are present, an approach in molar pattern is manifested; but in *Reithrodontomys* generic distinction is lodged in the grooved upper incisors. The genus *Zygodontomys*, until recently associated with *Oryzomys*, is similar in outward appearance and in general form of skull, but in height of molar crowns, absence of style ridges, and longitudinal instead of oblique commissures of cusps it departs widely from *Oryzomys* and more nearly approaches *Akodon*.

SUBGENERA AND MINOR GROUPS.

Of the three subgenera into which the North American species of the genus *Oryzomys* are here divided, *Oligoryzomys* and *Melanomys* each contain a single group of closely related forms, while the subgenus *Oryzomys* is divisible into seven rather well-defined minor groups, or assemblages, of species or subspecies (excluding *O. victus*, whose exact relationships are unknown). These assemblages are usually distinguishable by external characters, but recourse to cranial structure is sometimes necessary in order to make accurate determinations.

(1) The *O. palustris* group is characterized by large, robust form, small, coarsely haired ears, short vibrissæ, and the absence of conspicuous tufts of silvery bristles, which in all the other groups project beyond the ends of the longer claws on the hind feet. The skull is broad with short rostrum, very long anterior palatine foramina (normally reaching anterior plane of first molars), and large audital

bullæ. The principal reentrant angles normally reach less than halfway across the molar crowns. In the moderately worn crown of the second upper molar a crescentic central enamel island extends along the postero-internal base of the paracone.

(2) The *O. melanotis* group comprises slender, medium-sized, rich ochraceous-buffy or ochraceous-tawny species with large ears clothed externally with short, fine dusky hairs and internally with similarly short, fine rufescent hairs. The skull is narrow with elongated rostrum, short anterior palatine foramina, and small audital bullæ. The dentition departs slightly from the *O. palustris* type; the enamel arrangement is very similar but the reëntrant angles extend farther across the molar crowns.

(3) The *O. alfaroi* group includes small, dark-colored forms with short pelage, comparatively large, conspicuous ears clothed externally and internally with short, fine blackish hairs. The skull is small and delicate in structure. The dentition is similar to that of the *O. melanotis* group.

(4) The *O. talamancæ* group bears much superficial resemblance to the *O. alfaroi* group, but the members are usually brighter, more tawny in color. More distinctive characters are exhibited by the skull and teeth, especially the molar crown arrangement. In the grinding surface of the second upper molar the dentine ridge connecting paracone and protocone, owing to more posterior position, eliminates the large central enamel island present in the *O. alfaroi* group, and the crown of the third lower molar is much more than half cleft by the outer reentrant angle (about half cleft in the *O. alfaroi* group).

(5) The *O. bombycinus* group is easily recognized by very long pelage, that of the back measuring about 12 millimeters. The supraorbital vibrissæ reach the remarkable length of 50 to 70 millimeters. The dentition is about as in the *O. talamancæ* group.

(6) The *O. devius* group is distinguished by very large but rather slender form, relatively long tail (much longer than head and body), and dark general coloration. The dentition is similar to that of the *O. talamancæ* and *O. bombycinus* groups.

(7) The *O. tectus* group may be known by large size, rich tawny coloration, small ears clothed with rather coarse hairs of general body color, and short, stout hind feet. The skull is broad, with short rostrum and prominently projecting supraorbital ridges. The dentition is much as in the *O. talamancæ* group.

In the present revision 44 species and subspecies are assigned to the typical subgenus *Oryzomys*, 5 forms are placed in the subgenus *Oligoryzomys*, and 2 in the subgenus *Melanomys*.

List of North American Species and Subspecies, with Type Localities.

Subgenus ORYZOMYS.

Oryzomys palustris group:	
Oryzomys palustris palustris (Harlan)	"Fastland," near Salem, New Jersey.
palustris natator Chapman	Gainesville, Florida.
palustris coloratus Bangs	Cape Sable, Florida.
palustris texensis Allen	Rockport, Texas.
couesi couesi (Alston)	Coban, Guatemala.
couesi richmondi Merriam	Escondido River, Nicaragua.
couesi zygomaticus Merriam	Nenton, Guatemala.
couesi mexicanus Allen	Hacienda San Marcos, Jalisco, Mexico.
couesi aztecus Merriam	Yautepec, Morelos, Mexico.
couesi crinitus Merriam	Tlalpam, Federal District, Mexico.
couesi regillus Goldman	Los Reyes, Michoacan, Mexico.
couesi albiventer Merriam	Ameca, Jalisco, Mexico.
couesi peragrus Merriam	Rio Verde, San Luis Potosi, Mexico.
couesi aquaticus Allen	Brownsville, Texas.
fulgens Thomas	"Mexico."
gatunensis Goldman	Gatun, Canal Zone, Panama.
cozumelæ Merriam	Cozumel Island, Mexico.
antillarum Thomas	Jamaica.
peninsulæ Thomas	Santa Anita, Lower California, Mexico.
nelsoni Merriam	Maria Madre Island, Mexico.
Oryzomys melanotis group:	
Oryzomys melanotis melanotis Thomas	Mineral San Sebastian, Jalisco, Mexico.
melanotis colimensis, nobis	Armeria, Colima, Mexico.
rostratus rostratus Merriam	Metlaltoyuca, Puebla, Mexico.
rostratus megadon Merriam	Teapa, Tabasco, Mexico.
rostratus yucatanensis Merriam	Chichen Itza, Yucatan, Mexico.
Oryzomys alfaroi group:	
Oryzomys alfaroi alfaroi (Allen)	San Carlos, Costa Rica.
alfaroi dariensis Goldman	Cana, Panama.
alfaroi angusticeps Merriam	Volcan Santa Maria, Guatemala.
alfaroi rhabdops Merriam	Calel, Guatemala.
alfaroi caudatus Merriam	Comaltepec, Oaxaca, Mexico.
alfaroi palatinus Merriam	Teapa, Tabasco, Mexico.
alfaroi saturatior Merriam	Tumbala, Chiapas, Mexico.
alfaroi chapmani Thomas	Jalapa, Vera Cruz, Mexico.
alfaroi dilutior Merriam	Huauchinango, Puebla, Mexico.
guerrerensis Goldman	Omilteme, Guerrero, Mexico.
hylocetes Merriam	Chicharras, Chiapas, Mexico.
Oryzomys talamancæ group:	
Oryzomys talamancæ Allen	Talamanca, Costa Rica.
Oryzomys bombycinus group:	
Oryzomys bombycinus bombycinus Goldman	Cerro Azul, Panama.
bombycinus alleni Goldman	Tuis, Costa Rica.
Oryzomys devius group:	
Oryzomys devius Bangs	Boquete, Panama.
pirrensis Goldman	Mount Pirre, Panama.
Oryzomys tectus group:	
Oryzomys tectus tectus Thomas	Bugaba, Panama.
tectus frontalis Goldman	Corozal, Canal Zone, Panama.
Oryzomys victus[1] Thomas	St. Vincent, Lesser Antilles.

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[1] Not examined and group association not determined.

Subgenus OLIGORYZOMYS.

Oryzomys fulvescens fulvescens (Saussure)	Orizaba, Vera Cruz, Mexico.
fulvescens lenis Goldman	Los Reyes, Michoacan, Mexico.
fulvescens mayensis, nobis	Apazote, Campeche, Mexico.
fulvescens costaricensis Allen	El General, Costa Rica.
fulvescens vegetus Bangs	Boquete, Panama.

Subgenus MELANOMYS.

Oryzomys caliginosus idoneus Goldman	Cerro Azul, Panama.
caliginosus chrysomelas Allen	Suerre, Costa Rica.

Key to Subgenera.

a^1. Lachrymal articulating about equally with frontal and maxilla anteriorly; tail about equal to or longer than head and body.

b^1. Second upper molar with central enamel island normally elongated or absent; supraorbital and temporal ridges present; hind foot usually more than 25 .... **Oryzomys** (p. 17).

b^2. Second upper molar with central enamel island normally circular; supraorbital and temporal ridges absent; hind foot usually less than 25. **Oligoryzomys** (p. 87).

a^2. Lachrymal articulating almost entirely with maxilla anteriorly; tail about three-fourths length of head and body .... **Melanomys** (p. 94).

Subgenus ORYZOMYS Baird.

Subgeneric characters.—Color of upperparts usually contrasting strongly with that of underparts;[1] feet (epidermis and hairs), including toes, whitish, yellowish, or brownish;[1] tail about equal to or longer than head and body;[1] anterior border of lachrymal articulating about equally with maxilla and frontal;[1] supraorbital and temporal ridges usually prominent;[2] secondary parastyle well developed;[1] slightly worn crown of second upper molar with central enamel island elongated or absent;[2] upper incisors decidedly curved backward near points.[1]

Key to Species of the Subgenus Oryzomys.

[Typical adults.]

a^1. Habitat North America and Greater Antilles.

b^1. Hind foot without prominent tufts of digital bristles projecting beyond ends of three median claws.

c^1. Habitat Rio Grande Valley south to Panama, and including islands near coasts of Mexico and West Indies.

d^1. Habitat continental.

e^1. Supraorbital ridges not projecting prominently over orbits.

f^1. Head and shoulders not distinctly grayish.

g^1. Upperparts richer ochraceous-tawny. ("Mexico."). **O. fulgens** (p. 41).

g^2. Upperparts duller ochraceous-tawny or ochraceous-buffy. (Southern Texas to Costa Rica.) .... **O. couesi** (p. 28).

f^2. Head and shoulders distinctly grayish. (Lower California.) **O. peninsulæ** (p. 45).

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[1] Contrasting with *Melanomys*.

[2] Contrasting with *Oligoryzomys*.

e^2. Supraorbital ridges projecting prominently over orbits. (Panama.) **O. gatunensis** (p. 42).

d^2. Habitat insular.

e^1. Habitat islands off coasts of Mexico.

f^1. Upperparts ochraceous-buffy. (Maria Madre Island.). **O. nelsoni** (p. 46).

f^2. Upperparts ochraceous-tawny. (Cozumel Island.). **O. cozumelae** (p. 43).

e^2. Habitat Greater Antilles. (Jamaica.).......... **O. antillarum** (p. 44).

c^2. Habitat United States north of Rio Grande Valley.... **O. palustris** (p. 21).

b^2. Hind foot with prominent tufts of digital bristles projecting beyond ends of three median claws.

c^1. Ears clothed externally with fine blackish hairs contrasting with color of head; hind foot long and narrow.

d^1. Hind foot less than 33.

e^1. Supraorbital vibrissæ less than 40.

^{1}. Ears clothed internally with fine blackish hairs.

g^1. Second upper molar with central enamel island present; third lower molar with outer reentrant angle extending about half way across crown.

h^1. Upperparts darker ochraceous-buff or ochraceous-tawny.

i^1. Zygomata not wider anteriorly than posteriorly, or if wider zygomatic breadth more than 14. (Atlantic slope in eastern and southern Mexico and south to Panama.) **O. alfaroi** (p. 58).

i^2. Zygomata wider anteriorly than posteriorly; zygomatic breadth 14 or less. (Pacific slope of mountains of southern Chiapas.) **O. hylocetes** (p. 70).

h^2. Upperparts paler ochraceous-buff or ochraceous-tawny. (Pacific slope of Sierra Madre in Guerrero and Oaxaca.) **O. guerrerensis** (p. 69).

g^2. Second upper molar with central enamel island absent; third lower molar with outer reentrant angle extending more than half way across crown. (Costa Rica and Panama.). **O. talamancae** (p. 73).

f^2. Ears clothed internally with buffy or rusty reddish hairs.

g^1. Size larger; hind foot 30 or more. (Atlantic coast of Mexico.) **O. rostratus** (p. 52).

g^2. Size smaller; hind foot less than 30. (Pacific coast of Mexico.) **O. melanotis** (p. 49).

e^2. Supraorbital vibrissæ more than 50............ **O. bombycinus** (p. 76).

d^2. Hind foot 33 or more.

e^1. Color paler; supraorbital ridges absent. (Costa Rica and western Panama.) **O. devius** (p. 80).

e^2. Color darker; supraorbital ridges present. (Eastern Panama.) **O. pirrensis** (p. 81).

c^2. Ears clothed externally with coarse tawny hairs not contrasting with color of head; hind foot short and broad. (Costa Rica and Panama.) **O. tectus** (p. 84).

a^2. Habitat Lesser Antilles. (St. Vincent.)...................... **O. victus** (p. 86).

Oryzomys palustris Group.

Geographic distribution.—Coastal areas from southern New Jersey to southern Texas; north in the Mississippi Valley to southern Illinois, and southward from the Rio Grande Valley on the east, and southern

Sinaloa on the west, through Middle America to Panama, with outlying forms inhabiting southern Lower California, the Tres Marias Islands, and Cozumel Island. Confined mainly to the vicinity of water at low elevations, but ranging up to over 7,000 feet altitude in the marshy bottom of the Valley of Mexico (see maps, figs. 2 and 3).

General characters.—Size large; form robust; tail usually equal to or longer than head and body (shorter in some examples), thinly but rather distinctly haired; ears small and inconspicuous, well haired internally as well as externally; general pelage long, rather coarse and rigid; the underfur somewhat woolly; vibrissæ short, the longest arising from muzzle scarcely as long as head; hind feet broad, the upper surface rather well haired and under surface naked and coarsely granular anteriorly, becoming smooth along outer side of large posterior tubercle; inner edge of plantar surface overlapped by fringing bristles; toes of hind feet webbed near base; the claws long, relatively straight, and projecting well beyond overlapping bristles. Color of upperparts presenting a wide range of variation from grizzled grayish brown, or pale buff, to rich ochraceous-buff or ochraceous-tawny, more or less heavily overlaid with black; underparts ranging from white to light ochraceous-buff.

Skull.—Size large, with rostrum short and braincase high and well arched; outer wall of antorbital foramen with superior border extending well forward, the foramen appearing as a deep circular notch as viewed from above; frontal region rather broad, the lateral margins trenchant, somewhat upturned, and projecting as supraorbital ridges, frontals usually encroaching in a narrow point posteriorly along the median line between the parietals; temporal ridges well developed anteriorly along parieto-squamosal borders, usually becoming indistinct posteriorly in crossing lateral wings of parietals to low lambdoid crest; interparietal small, subtriangular, the anterior border a nearly straight line and the posterior with an ill-defined median angle; anterior palatine foramina narrow and much elongated, about equal in length to palatal bridge, normally reaching posteriorly to anterior plane of first molars, the median septum with posterior or maxillary portion contracted and anterior or premaxillary section expanded above; palatal pits large and normally oval in outline; interpterygoid fossa moderately broad; sphenopalatine vacuities large in *O. palustris*, absent, or present as very narrow slits, in *O. couesi* and related forms; audital bullæ large, the swollen portion projecting anteriorly beyond anterior plane of basioccipital; basioccipital narrow; angle of mandible rather broad and projecting posteriorly; coronoid process large, rising high above condyle; dentition moderately heavy; third lower molar rather short and broad; mandibular toothrow only slightly narrower posteriorly than anteriorly; inner reëntrant angles in upper molars and outer reentrant angles in lower molars reaching less than half way across moderately worn crowns; second upper molar with a somewhat crescentic enamel island, or furrow, along postero-internal base of paracone, becoming restricted and finally obliterated through extended wear; tubercle over root of lower incisor prominent.

Remarks.—The *O. palustris* group includes *O. palustris* of the United States, and *O. couesi* and nearly related Middle American forms. Aside from the darker, more brownish colors which usually characterize *O. palustris*, in contrast with the brighter, more ochraceous buffy or rufescent tones of *O. couesi* and its relatives, these sections of the group also differ notably in quality of pelage, the overfur being longer and projecting farther beyond the underfur in the former than in the latter. The forms of the two sections of the group agree closely in essential cranial details, but skulls of subspecies of *O. palustris* are usually recognizable by the large size of the sphenopalatine vacuities. Members of the group as a whole are distinguished externally from those of other Middle American groups of the same subgenus by the small size and internal as well as external hairiness of the ears.

Key to Species and Subspecies of the O. palustris Group.

[Typical adults.]

- *a*¹. Upperparts mainly grayish or brownish, or if ochraceous-buffy or ochraceous-tawny underparts not distinctly buffy. (United States north of Rio Grande Valley [*O. palustris*].)
  - *b*¹. Upperparts mainly grayish or brownish.
    - *c*¹. Color darker. (Atlantic coast region from southern New Jersey to northern Florida; Alabama; southeastern Mississippi; central Tennessee; southern Kentucky; southern Illinois, and parts of southeastern Missouri.) **O. p. palustris** (p. 22).
    - *c*². Color paler. (Coast region of Texas from Nueces Bay northward; Louisiana; western Mississippi; southern and eastern Arkansas; extreme southeastern Missouri; southeastern Kansas.) .... **O. p. texensis** (p. 27).
  - *b*². Upperparts mainly clay color or ochraceous-tawny.
    - *c*¹. Color duller, less distinctly ochraceous-tawny. (North-central Florida.) **O. p. natator** (p. 24).
    - *c*². Color brighter, more distinctly ochraceous-tawny. (Southern Florida.) **O. p. coloratus** (p. 26).
- *a*². Upperparts mainly ochraceous-buffy or ochraceous-tawny. (Rio Grande Valley to Panama and islands near coasts of Mexico and West Indies [*O. couesi* and related forms].)
  - *b*¹. Habitat continental.
    - *c*¹. Supraorbital ridges not projecting prominently over orbits.
      - *d*¹. Head and shoulders not distinctly grayish.
        - *e*¹. Upperparts duller ochraceous-tawny or ochraceous-buffy. [*O. couesi* and subspecies.]
          - *f*¹. Underparts normally white.
            - *g*¹. Size larger; hind foot usually 35 or more; upper molar series usually more than 5.

h^1. Upperparts more intense ochraceous-buff. (Northwestern Michoacan)................................ **O. c. regillus** (p. 37).

h^2. Upperparts less intense ochraceous-buff. (Central Jalisco.) **O. c. albiventer** (p. 38).

g^2. Size smaller; hind foot usually less than 35; upper molar series usually less than 5.

h^1. Upperparts darker ochraceous-buff. (Pacific coastal region from southern Sinaloa to southeastern Oaxaca.) **O. c. mexicanus** (p. 33).

h^2. Upperparts paler ochraceous-buff. (Morelos; southern Puebla; northern Oaxaca; northeastern Guerrero.). **O. c. aztecus** (p. 35).

f^2. Underparts normally buffy.

g^1. Size larger; hind foot usually more than 33; upper molar series usually more than 4.8.

h^1. Size smaller; hind foot averaging less than 35.

i^1. Color darker. (San Luis Potosi.)..... **O. c. peragrus** (p. 39).

i^2. Color paler. (Rio Grande Valley.).. **O. c. aquaticus** (p. 39).

h^2. Size larger; hind foot averaging about 36. (Valley of Mexico.) **O. c. crinitus** (p. 36).

g^2. Size smaller; hind foot usually less than 33; upper molar series usually more than 4.8.

h^1. Upperparts normally ochraceous-buffy.

i^1. Color darker. (Northern Vera Cruz to northwestern Costa Rica.)................................ **O. c. couesi** (p. 29).

i^2. Color paler. (Southwestern Gautemala and south-central Chiapas.)....................... **O. c. zygomaticus** (p. 32).

h^2. Upperparts normally ochraceous-tawny. (Lowlands of eastern Nicaragua.).......................... **O. c. richmondi** (p. 32).

e^2. Upperparts richer ochraceous-tawny. (Mexico.)...... **O. fulgens** (p. 41).

d^2. Head and shoulders distinctly grayish. (Lower California.) **O. peninsulæ** (p. 45).

c^2. Supraorbital ridges projecting prominently over orbits. (Panama.) **O. gatunensis** (p. 42).

b^2. Habitat insular.

c^1. Habitat off east coast of Mexico. (Cozumel Island.).. **O. cozumelæ** (p. 43).

c^2. Habitat off west coast of Mexico. (Maria Madre Island.). **O. nelsoni** (p. 46).

c^3. Habitat West Indies. (Jamaica.)................. **O. antillarum** (p. 44).

ORYZOMYS PALUSTRIS (HARLAN).

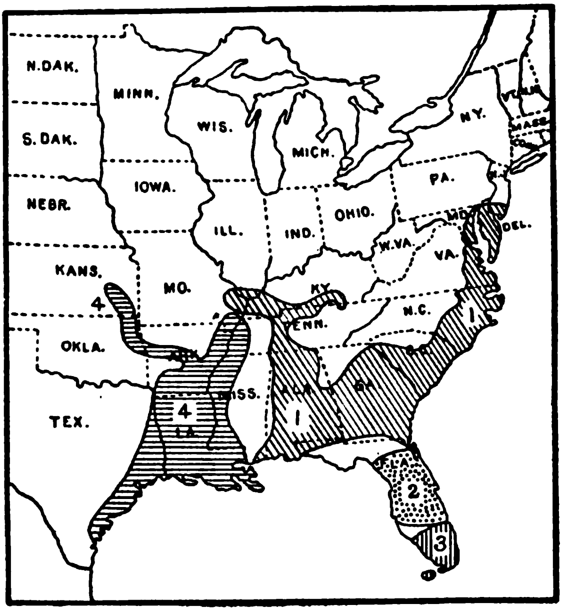
[Synonymy under subspecies.]

Geographic distribution.—Atlantic and Gulf coastal areas from southern New Jersey (not yet recorded from Delaware and Maryland, but doubtless occurs there), to southern Texas, and north through the Mississippi Valley to southern Kentucky, southern Illinois, and eastern Kansas (fig, 2). Altitudinal range from sea level up along streams to about 500 feet altitude (rarely to 1,000 feet), mainly in the Lower Austral Zone, but reaching into the Upper Austral Zone in the more northerly localities, and into the Tropical Zone in southern Florida.

General characters.—Similar in general to *O. couesi*, but pelage longer; colors usually darker and duller grayish brown instead of ochraceous-buffy or ochraceous-tawny; skull differing in various details, but dentition about the same.

Color.—Upperparts in general varying from grizzled grayish brown or pale buff, to tawny-olive, clay color, and ochraceous-tawny; the face, top of head, and back heavily lined or overlaid with black; sides paler, owing to a thinner admixture of blackish hairs; underparts white, varying to buffy white and rarely to pale buff; outer sides of ears dusky, the inner sides clothed with grayish or rusty hairs; feet whitish; tail varying from brownish above and whitish below to dusky all round. *Young* (in first pelage): Varying from grayish brown to dull tawny-olive above, whitish below.

Skull.—(For general outlines see under *O. palustris* group.) In general form closely resembling that of *O. couesi*, but sphenopalatine vacuities, absent or much reduced in size in that species, large and widely open; antorbital foramen with anterior border less rounded above, less inclined or produced forward at the base, in many examples somewhat excised or tending to develop a point as in *Sigmodon*.



1. *O.p.palustris.* 2. *O.p.natator.* 3. *O.p.coloratus.* 4. *O.p.texensis.*
FIG. 2.—Geographic distribution of subspecies of *Oryzomys palustris.*

Remarks.—*O. palustris* is divisible into four geographic races which form a closely intergrading series. The species apparently attains its largest size in Florida and along the coast of the Gulf of Mexico east of the Mississippi delta.

ORYZOMYS PALUSTRIS PALUSTRIS (HARLAN).

SWAMP RICE RAT.

[Pl. I, figs. 1, 1a; Pl. V, figs, 1, 4; Pl. VI, figs. 1, 1a.]

Mus palustris Harlan, Silliman's Amer. Journ. Sci., XXXI, p. 385, 1837.
Arvicola oryzivora, Bachman, in Audubon and Bachman, Quadr. North Amer., III, p. 214, 1854. Type from St. Johns Parish, South Carolina.
H[esperomys] palustris Wagner, in Suppl. Schreber's Saügthiere, III, p. 543, 1843.
Oryzomys palustris Baird, Mamm. North Amer., p. 459, 1857.

Type locality.—"Fastland," near Salem, Salem County, New Jersey.

Type.—Not known to exist.

Geographic distribution.—Atlantic coastal areas from southern New Jersey (not yet known from Delaware or Maryland, but doubtless occurs there) south to northeastern Florida, thence westward through southern Georgia to the Gulf coast of Alabama and Mississippi, and north through Alabama and western Tennessee to southwestern Kentucky, southern Illinois, and parts of southeastern Missouri. Altitudinal range from sea level up along streams to about 500 feet (rarely to 1,000 feet), mainly in Lower Austral Zone, but reaching into Upper Austral Zone in southern New Jersey, southeastern Kentucky, and southeastern Missouri (Marble Hill).

General characters.—Size usually smaller and color more brownish, less tawny, than in *O. p. natator* and *O. p. coloratus;* skull less massive. Closely resembling *O. p. texensis*, but darker, more brownish than topotypes of the latter form; skull broader.

Color.—*Fresh pelage* (December): Upperparts grizzled grayish brown or pale buff, the brownish or buffy tone most intense on rump, darkened on face, top of head, and back by overlying blackish hairs; feet whitish; tail brownish above, whitish below, becoming in some specimens dark all round near tip. *Young* (in first pelage): Grayish brown above, dull whitish below.

Skull.—(For general outlines see under *O. palustris* group.) Very similar to those of *O. p. natator* and *O. p. coloratus*, but narrower; braincase decidedly narrower; zygomata less widely spreading; frontal region narrower, the supraorbital borders less projecting. Compared with that of *O. p. texensis* the skull differs mainly in somewhat larger average size; zygomata usually more widely spreading.

Measurements.—Average of four adults from Greenwich, N. J. (near type locality): Total length, 242 (237–245); tail vertebræ, 112 (109–116); hind foot, 31 (30–31.5). An adult from Pope Creek, Va.: 260; 130; 33. Average of four adults from Georgetown, S. C.: 257 (233–273); 125 (113–132); 32.5 (31–33). Average of three adults from Bon Secour, Ala.: 265 (250–280); 131 (125–138); 30.5 (30–31.5). Adult from Bayou La Batre, La.: 233; 116; 30. Adult from Marble Hill, Mo.: 252; 115; 29. Adult from Olive Branch, Ill.: 255; 113 29. Adult from Barbourville, Ky.: 270; 133; 30.5. *Skull* (two adults from Greenwich, N. J.: Greatest length, 32.4, 31; zygomatic breadth, 17.2, 16.6; interorbital breadth, 5.2, 5.1; width of braincase, 11.9, 12; nasals, 12.7, 12; anterior palatine foramina, 6.7, 6.7; palatal bridge, 6.2, 6.2; upper molar series, 4.5, 4.6.

Remarks.—*O. p. palustris* passes into *O. p. texensis* in the Mississippi Valley. Specimens from Marble Hill, Mo., and Olive Branch, Ill., however, seem referable to the typical form. A tendency to develop the ruddy color and more massive skull of *O. p. natator* is exhibited by specimens from New Berlin and Burnside Beach, northern Florida, and intergradation of the two forms seems evident in that part of the State. No rice rats have been recorded from Delaware or Maryland, but the favorable character of the country and the narrowness of the gap between collecting stations to the north and south point to probable continuity of range. Specimens from South Carolina apparently representing *Arvicola oryzivora* of Audubon and Bachman are inseparable from typical *palustris*.

Specimens examined.—Total number, 233, as follows:

Alabama: Autaugaville, 1; Bayou La Batre, 2; Bon Secour, 3; Elmore, 1; Florence, 1; Gallion, 1; Hayneville, 2; Huntsville, 4; Jackson, 2; Mobile, 1; Montgomery, 1; Mount Weogufka, 1; Reform, 1; Sand Mountain (near Carpenter), 1; Seale, 1.

Florida: Burnside Beach, 9;[1] New Berlin, 8.[2]

Georgia: Cumberland Island, 14;[3, 4] Hursman Lake, 1;[1] McIntosh County, 1; Okefinokee Swamp, 1;[2] Ossabaw Island, 12;[1] Riceboro, 7;[5] Saint Marys, 20;[3, 6] Savannah, 10; Toccoa, 2.

Illinois: Olive Branch, 3.

Kentucky: Barbourville, 3.

Missouri: Marble Hill, 1.

Mississippi: Biloxi, 1.

New Jersey: Cedar Creek, 1;[7] Greenwich, 13.[8]

North Carolina: Coinjock, 1; Pea Island, 2;[1] Raleigh, 31.[9, 10]

South Carolina: Beaufort County, 2; Calhoun Falls, 2;[3] Easley, 1; Frogmore, 1;[3] Georgetown, 11; Plantersville, 7; Saint Helena Island, 1; Society Hill, 3.

Tennessee: High Cliff, 1; Lawrenceburg, 2.

Virginia: Dismal Swamp, 20; Pope Creek (5 miles southeast of Colonial Beach), 2; Smith Island, 6; Suffolk, 1; Wallops Island, 3; Warsaw (4 miles southwest), 5; Wreck Island, 1.

ORYZOMYS PALUSTRIS NATATOR CHAPMAN.

CENTRAL FLORIDA RICE RAT.

Oryzomys palustris natator Chapman, Bull. Amer. Mus. Nat. Hist., V., p. 44, March 17, 1893.

Type locality.—Gainesville, Alachua County, Florida.

Type.—No. $\frac{1818}{1089}$, ♂ adult, American Museum of Natural History; collected by F. M. Chapman, January 31, 1889.

Geographic distribution.—Central Florida, north of Everglades; Austroriparian division of Lower Austral Zone.

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[1] Collection Mus. Comp. Zool.

[2] Collection Field Mus. Nat. Hist.

[3] Collection Amer. Mus. Nat. Hist.

[4] Eleven in collection Mus. Comp. Zool.

[5] Five in collection Field Mus. Nat. Hist.

[6] Three in collection Field Mus. Nat. Hist.; 15 in Mus. Comp. Zool.

[7] Collection Acad. Nat. Sci. Philadelphia.

[8] Five in collection Acad. Nat. Sci. Philadelphia.

[9] Five in collection Amer. Mus. Nat. Hist.

[10] Two in collection Field Mus. Nat. Hist.; 6 in Mus. Comp. Zool.

General characters.—Most like *O. p. coloratus;* differing usually in less intense tawny suffusion of upperparts, especially cheeks and sides of body. Size larger, color more tawny, and skull more massive than usual in *O. p. palustris* or *O. p. texensis.*

Color.—*Fresh pelage* (December): Upperparts varying from grizzled grayish brown or pale buff to tawny-olive, clay color, or ochraceous-tawny, deepest and richest on lower part of back and rump, becoming paler and more buffy on sides, and darkened dorsally by admixture of blackish hairs; face grayish or pale buffy beneath overlying dusky hairs; underparts usually white, but in some specimens more or less suffused with pale buff; feet white; tail brownish above, whitish below, becoming in some specimens dark all round toward tip. *Young* (in first pelage): Brownish or dull tawny-olive mixed with black above, whitish below.

Skull.—Similar to those of *O. p. palustris* and *O. p. texensis*, but broader; braincase decidedly broader; zygomata more widely spreading; frontal region broader, the supraorbital borders more projecting. Comparison with the skull of *O. p. coloratus* reveals no appreciable difference.

Measurements.—Type: Total length, 295; tail vertebræ, 143; hind foot (dry skin), 33. Average of 10 adults (type and 9 topotypes): 276.7 (271–300); 142.9 (132–156); 34.3 (32.5–37). *Skull* (average of 6 adults, type and 5 topotypes): Greatest length, 32.4 (31.4–33.7); zygomatic breadth, 17.2 (16.4–17.7); interorbital breadth, 5.4 (5.1–6.1); width of braincase, 12.4 (12–12.8); nasals, 12.7 (12–13.5); anterior palatine foramina, 6.9 (6.4–7.2); palatal bridge, 6.1 (5.7–6.5); upper molar series, 4.7 (4.5–4.9).

Remarks.—In northern Florida, not far to the northward of the type locality, *O. p. natator* passes into *O. p. palustris*, as shown by specimens from New Berlin and Burnside, which, however, seem more properly placed with the latter form. In the vicinity of Lake Okechobee *natator* merges with *O. p. coloratus*, a richer colored form inhabiting the southern part of the State.

Specimens examined.—Total number, 121, as follows:

Florida: Anastasia Island, 2;[1] Canaveral, 4; Cape Canaveral, 3; Cartersville, 1; Crystal River, 1;[1] Enterprise, 26;[2] Espanita, 3;[3] Fort Kissimmee, 1; Gainesville, 19 (type and topotypes);[4] Geneva, 1; Kissimmee, 2; Kissimmee River, 2; Lake Harney, 11; Lake Kissimmee, 19; Micco, 9;[5] Mullet Lake, 1; Oak Lodge, 9;[1] Ocala, 2; Tarpon Springs, 1;[6] Titusville, 4.

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[1] Collection Mus. Comp. Zool.

[2] Fourteen in collection Amer. Mus. Nat. Hist.; 10 in Field Mus. Nat. Hist.; 2 in Mus. Comp. Zool.

[3] Collection Field Mus. Nat. Hist.

[4] Nine in collection Amer. Mus. Nat. Hist.; 5 in Field Mus. Nat. Hist.; 5 in Mus. Comp. Zool.

[5] Three in collection Amer. Mus. Nat. Hist.; 3 in Field Mus. Nat. Hist.

[6] Collection Acad. Nat. Sci. Philadelphia.

ORYZOMYS PALUSTRIS COLORATUS Bangs.

Everglades Rice Rat.

(Pl. I, figs. 2, 2a.)

Oryzomys palustris coloratus Bangs, Proc. Boston Soc. Nat. Hist., XXVIII, p. 189, March, 1898.

Oryzomys natator floridanus Merriam, Proc. Washington Acad. Sci., III, p. 277, July 26, 1901. Type from Everglade, Florida, No. 71349, ♂ ad., U. S. Nat. Mus. (Biological Survey collection); collected by J. Alden Loring, March 29, 1895.

Type locality.—Cape Sable, Monroe County, Florida.

Type.—No. 4470, ♂ adult, Museum of Comparative Zoology (collection of E. A. and O. Bangs); collected by C. L. Brownell, April 17, 1895.

Geographic distribution.—Tropical southern Florida, north to Lake Okechobee.

General characters.—Closely resembling *O. p. natator;* differing in more intense tawny suffusion of upperparts; size about the same. Size larger than usual in *O. p. palustris* and *O. p. texensis*, and color much more tawny than either.

Color.—About as in *O. p. natator*, but general tone of upperparts slightly richer, more tawny or rufescent.

Skull.—Like that of *O. p. natator.*

Measurements.—Type: Total length, 301; tail vertebræ, 150; hind foot, 35. Average of three adult topotypes: 296 (278–305); 144 (133–152); 33.4 (33.4–33.4). *Skull* (average of four adults, type and three topotypes): Greatest length, 32.2 (31.8–32.7); zygomatic breadth, 17.1 (16.8–17.5); interorbital breadth, 5.8 (5.8–5.9); width of braincase, 12.4 (12.2–12.5); nasals, 12.4 (12.1–12.6); anterior palatine foramina, 6.6 (6.3–7); palatal bridge, 6.1 (5.7–6.6); upper molar series, 4.8 (4.7–4.9).

Remarks.—*O. p. coloratus* requires close comparison with *O. p. natator*, from which it apparently differs only in color. The richer tone in *coloratus* is most noticeable when specimens are turned on their sides, and the cheeks and flanks contrasted with those of examples of *natator*. As Bangs rightly states, *coloratus* "occupies only the southern, tropical part of the Florida peninsula."

In describing "*Oryzomys natator floridanus*," Merriam overlooked the name *coloratus*, which had already been applied to the animal of the region; the two are clearly synonymous.

Specimens examined.—Total number, 50, as follows:

Florida: Cape Sable, 11 (type and topotypes);[1] Eden, 1; Everglade, 16 (including type of "*floridanus*"); Flamingo, 13;[2] Juno (Lake Worth), 5; Jupiter, 2;[1] Miami, 1; Miami River, 1.

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[1] Collection Mus. Comp. Zool. [2] Twelve in collection Mus. Comp. Zool.; 1 in Amer. Mus. Nat. Hist.

ORYZOMYS PALUSTRIS TEXENSIS Allen.

Texas Rice Rat.

Oryzomys palustris texensis Allen, Bull. Amer. Mus. Nat. Hist., VI, p. 177, May 31, 1894.

Type locality.—Rockport, Aransas County, Texas.

Type.—No. $\frac{7166}{5764}$, ♂ ad., American Museum of Natural History; collected by H. P. Attwater, November 15, 1893.

Geographic distribution.—From Corpus Christi Bay north and east along the Gulf coast of Texas and Louisiana to the delta of the Mississippi, thence north in the Mississippi Valley to southeastern Missouri; general range reaching southeastern Kansas, probably by way of the Arkansas River valley through Oklahoma (not yet known from Oklahoma); altitudinal range in Austroriparian Zone, mainly below 500 feet, but extending up to about 1,000 feet in Kansas.

General characters.—Closely resembling *O. p. palustris*, but typical examples paler; skull usually narrower. Color paler, less rufescent, and skull decidedly narrower, less massive, than in *O. p. natator* and *O. p. coloratus*.

Color.—About as in *O. p. palustris*, but averaging slightly paler. An ochraceous-tawny suffusion of upperparts and underparts is shown in rare examples.

Skull.—About like that of *O. p. palustris*, but averaging somewhat smaller, with less widely spreading zygomata. Similar to that of *O. p. natator*, but narrower; braincase decidedly narrower; zygomata less widely spreading; frontal region narrower, the supraorbital borders less projecting.

Measurements.—Type: Total length, 256; tail vertebræ, 139; hind foot, 30.5. Average of eight adult topotypes: 242 (226–279); 120 (108–133); 29 (28.5–30.5). *Skull* (average of 5 adults—type and 4 topotypes): Greatest length, 31 (30–32.1); zygomátic breadth, 16 (15.2–16.8); interorbital breadth, 5.3 (5.2–5.4); width of braincase, 11.8 (11.1–12.3); nasals, 12.5 (12–12.9); anterior palatine foramina, 6.1 (5.7–6.5); palatal bridge, 5.8 (5.5–6.1); upper molar series, 4.4 (4.3–4.7).

Remarks.—Specimens from the type locality are paler than those from other localities in the immediate vicinity, some of which are practically indistinguishable from many typical examples of *O. p. palustris*. Moreover, in cranial characters, especially in width of braincase and outward spread of zygomata (characters which distinguish *O. p. texensis* from *O. p. natator* and *O. p. coloratus*), *texensis* very closely approaches *palustris*. The skull of the type and larger topotypes of *texensis* seem inseparáble from some of the smaller skulls of comparable age from the region of the type locality of *palustris*. The cranial difference noted, however, affects the majority of individuals, and together with a tendency toward pallid coloration exhibited by animals inhabiting a wide area, seems to entitle *texensis* to recognition as a separate form. The few specimens available from Arkansas, western Tennessee, and extreme southeastern Missouri seem referable to *texensis*, but approach *palustris* so closely that they might with nearly equal propriety be assigned to that subspecies.

Specimens examined.—Total number, 110, as follows:

Arkansas: Camden, 2; Delight, 1; Lake City, 1; Wilmot, 1.
Kansas: Neosho Falls, 2.[1]
Louisiana: Burbridge, 18;[2] Gibson, 4;[3] Houma, 1; Iowa, 3; Lake Catherine, 6;[3] Main Pass, 2; Mermenton, 4;[4] New Orleans, 2.
Mississippi: Fayette, 1.
Missouri: Kennett, 2; Portageville, 1.
Tennessee: Arlington, 1.
Texas: Corpus Christi, 7;[5] Matagorda, 7; Matagorda Island, 2; Matagorda Peninsula, 1; Nueces Bay, 5; Padre Island, 4; Port Lavaca, 4; Rockport, 24 (type and topotypes);[6] Sabine, 1; Victoria, 1; Virginia Point, 1; Wharton County, 1.[3]

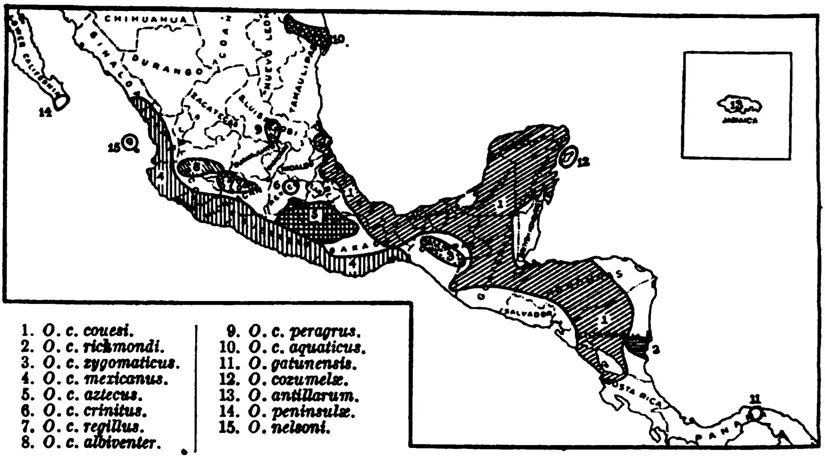

FIG. 3.—Geographic distribution of *Oryzomys couesi* and related species.

ORYZOMYS COUESI (ALSTON).

[Synonymy under subspecies.]

Geographic distribution.—River valleys and marshy areas from southern Texas on the east and southern Sinaloa on the west, south through central and southern Mexico, Guatemala, Honduras, and Nicaragua to northern Costa Rica. Altitudinal range from sea level, regardless of latitude, to over 7,000 feet in the Valley of Mexico; zonal range mainly Tropical but reaching into Sonoran Zone on the tableland of Mexico (fig. 3).

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[1] One in Mus. Comp. Zool.
[2] Collection Mus. Comp. Zool.
[3] Collection Amer. Mus. Nat. Hist.
[4] Collection Field Mus. Nat. Hist.
[5] One in collection Amer. Mus. Nat. Hist.
[6] Nineteen in collection Amer. Mus. Nat. Hist.; 2 in Field Mus. Nat. Hist.; 1 in Mus. Comp. Zool.

General characters.—Similar in general to *O. palustris*, but pelage shorter; colors usually brighter and richer, ochraceous-buffy or ochraceous-tawny instead of grayish brown; skull differing in various details, but dentition about the same.

Color.—Upperparts varying from light buff or pinkish buff through ochraceous-buff to ochraceous-tawny, more or less suffused with tawny or russet, the general shade paler on cheeks, shoulders, and along sides, becoming deeper, more intense, and darkened on face, top of head, and back by admixture of black hairs; underparts varying from nearly pure white through light buff to light ochraceous-buff, more or less suffused with pale salmon color; outer sides of ears blackish, inner sides moderately clothed with short hairs varying from grayish to ochraceous-buff or rusty reddish; feet white; tail dark brownish above, whitish or light brownish below.

Skull.—(For general outlines see under *O. palustris* group.) In general form closely resembling that of *O. palustris*, but sphenopalatine vacuities, large in that species, absent or much reduced in size; antorbital foramen with anterior border more rounded above, more inclined or produced forward at the base, not excised or tending to develop the somewhat *Sigmodon*-like point often present in *palustris;* interparietal with a more evident posterior angle.

Remarks.—Ten geographic races of *O. couesi* appear to be recognizable in the area between the valley of the Rio Grande, Texas, and northern Costa Rica. While all the more minute steps of intergradation are not always shown by the material now available, mainland forms throughout this wide interval agree so closely in all essential details that they seem safely assignable to a single species. Several outlying insular forms (and *O. peninsulæ* of Lower California) exhibit more distinctive characters and are accorded specific rank, but they are clearly related to the widely ranging *O. couesi* section of the *O. palustris* group.

ORYZOMYS COUESI COUESI (Alston).

Coues Rice Rat.

(Pl. I, figs. 3, 3a.)

Hesperomys couesi Alston, Proc. Zool. Soc. London, 1876, p. 756.

Oryzomys couesi Thomas, Ann. Mag. Nat. Hist.; ser. 6, XI, p. 403, May 1893 (type and locality fixed).

Oryzomys jalapæ Allen and Chapman, Bull. Amer. Mus. Nat. Hist., IX, p. 206, June 16, 1897. Type from Jalapa, Vera Cruz, Mexico (altitude 4,400 ft.). No. $\frac{12551}{10861}$, ♂ ad., Amer. Mus. Nat. Hist.; collected by F. M. Chapman, April 16, 1897.

Oryzomys jalapæ rufinus Merriam, Proc. Washington Acad. Sci., III, p. 285, July 26, 1901. Type from Catemaco, Vera Cruz, Mexico (altitude 1,000 feet). No. 65499, ♀ ad., U. S. Nat. Mus. (Biological Survey collection); collected by Nelson and Goldman, April 27, 1894.

Oryzomys teapensis Merriam, Proc. Washington Acad. Sci., III, p. 286, July 26, 1901. Type from Teapa, Tabasco, Mexico. No. 99973, ♂ subad., U. S. Nat. Mus. (Biological Survey collection); collected by Nelson and Goldman, April 4, 1900.

Oryzomys goldmani Merriam, Proc. Washington Acad. Sci., III, p. 288, July 26, 1901. Type from Coatzacoalcos, Vera Cruz, Mexico (near sea level). No. 78110, ♀ ad., U. S. Nat. Mus. (Biological Survey collection); collected by Nelson and Goldman, April 11, 1896.

Oryzomys jalapæ apatelius Elliot, Field Columb. Mus., publ. 90, zool. ser., III, p. 266, March 8, 1904. Type from San Carlos, Vera Cruz, Mexico. No. 13107, ♀ ad., Field Mus. Nat. Hist.; collected by N. G. Buxton, March 1, 1903.

Oryzomys richardsoni Allen, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 99, April 30, 1910. Type from Pena Blanca, Nicaragua. No. 29800, ♂ ad., Amer. Mus. Nat. Hist.; collected by Wm. B. Richardson, May 25, 1909.

Type locality.—Coban, Guatemala.

Type.—In British Museum; collected by Osbert Salvin.

Geographic distribution.—From northern Vera Cruz southeastward through eastern Puebla, eastern Oaxaca, northern and extreme southern Chiapas, Tabasco, Campeche, Yucatan, Quintana Roo, Guatemala, Honduras, and Nicaragua, to northwestern Costa Rica; altitudinal range from sea level to about 5,000 feet mainly in Humid Lower Tropical Zone.

General characters.—Size about as in *O. c. zygomaticus*, *O. c. mexicanus* and *O. c. richmondi;* color slightly darker than in *zygomaticus*, decidedly darker than in *mexicanus*, and decidedly paler than in *richmondi;* skull about like those of *mexicanus* and *richmondi;* sphenopalatine vacuities absent or represented by very narrow slits as usual in the *O. couesi* section of the *O. palustris* group. Similar in general to *O. c. peragrus*, but somewhat smaller, with upperparts, especially cheeks, shoulders, and sides, more ochraceous-buffy; skull less massive.

Color.—*Fresh pelage:* Upperparts varying from ochraceous-buffy to ochraceous-tawny, deepened in rare examples to light cinnamon-brown, lightest on cheeks, shoulders, and along sides, the face, top of head, and back much darkened by black hairs; underparts varying from light buff to light ochraceous buff (rarely dull white); outer sides of ears blackish, the inner sides clothed with short ochraceous-buffy hairs; feet white; tail brownish above, dull yellowish below proximally, becoming light brownish toward tip.

Skull.—About as in *O. c. zygomaticus*, *O. c. mexicanus*, and *O. c. richmondi;* differing mainly in smaller general size, decidedly narrower braincase, and smaller molars than those of *O. c. crinitus*, *O. c. albiventer*, and other Mexican tableland forms. Similar to that of *O. c. peragrus*, but braincase narrower.

Measurements.—Average of 4 adults from Tumbala, Chiapas: Total length, 252 (242–265); tail vertebræ, 130 (127–135); hind foot, 30.7 (30–31). Average of 10 adults from Yaruca, Honduras: 267.5 (255–280); 138 (130–145); 29.1 (28–32). Average of seven adults from Orizaba, Vera Cruz: 263 (248–294); 148 (139–174); 33.1

(32–34.5). *Skull* (average of 5 adults from Yaruca, Honduras): Greatest length, 30.5 (29.9–31.3); zygomatic breadth, 16 (15.5–17.2); interorbital breadth, 4.8 (4.5–5.1); width of braincase, 11.4 (11.2–11.6); nasals, 11.9 (11.4–12.4); anterior palatine foramina, 6 (5.5–6.2); palatal bridge, 5.5 (5.3–6.1); upper molar series, 4.7 (4.5–4.8).

Remarks.—In the absence of material from the type locality as fixed by Thomas, specimens from Tumbala, Chiapas; and Yaruca, Honduras, which agree closely with his description, are assumed to represent typical *couesi* and have been used as a basis for comparison. Individual variation in size, color, and cranial details exhibited by every large series of *O. c. couesi* is very striking, but the form maintains with remarkable constancy its essential characters throughout its wide range. Examples from northern Vera Cruz and eastern Puebla present the same general variations and are not satisfactorily separable from those from Honduras and Nicaragua. This variation has resulted in the publication of several names based on characters which prove to be inconstant in the large number of specimens passed in review. Specimens from various localities indicate direct intergradation with *O. c. zygomaticus*, *O. c. mexicanus*, and *O. c. peragrus*.

Specimens examined.—Total number, 199, as follows:

Campeche: La Tuxpeña, 1.
Chiapas: Chicharras, 4; Tumbala, 6.
Costa Rica: Bahia de Salinas, 1.[1]
Guatemala: Jacaltenango, 3.
Honduras: Yaruca, 35.[2]
Nicaragua: Chontales, 22;[1] Matagalpa, 4;[1] Ocotal, 2;[1] Peña Blanca, 8 (including type of "*richardsoni*");[1] Quilali, 1;[1] Rio Coco, 14;[1] Rio Grande, 1;[1] Rio San Juan del Norte, 1;[1] Rio Tuma, 2;[1] San Juan, 1;[1] Tuma, 5;[1] Uluce, 1;[1] Vijagua, 2.[1]
Oaxaca: Comaltepec, 1; Guichicovi, 3; Reforma, 1[3]; Santo Domingo (mountain near), 8; Tuxtepec, 2.
Puebla: Huauchinango, 1; Metlaltoyuca, 11.
Quintana Roo: Santa Lucia, 3.[4]
Tabasco: Teapa, 3 (including type of "*teapensis*").
Vera Cruz: Achotal, 4;[3] Buena Vista, 2; Catemaco, 2 (including type of "*rufinus*"); Jalapa, 4 (including type of "*jalapæ*");[1] Pasa Nueva, 1;[1] Coatzacoalcos, 3 (including type of "*goldmani*"); Jico, 2;[3] Mirador, 1; Motzorongo, 1; San Carlos, 3 (including type of "*apatelius*");[3] Orizaba, 16;[5] Rivera (75 miles south), 1; Papantla, 1· Teocelo, 1;[4] Tlacotalpam, 7; Ubero, 1.
Yucatan: Rio Lagartos, 2.[3]

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[1] Collection Amer. Mus. Nat. Hist.

[2] Twenty-six specimens in Mus. Comp. Zool.; 6 in Field Mus. Nat. Hist.

[3] Collection Field Mus. Nat. Hist.

[4] Collection Mus. Comp. Zool.

[5] Two in Field Mus. Nat. Hist.

ORYZOMYS COUESI RICHMONDI Merriam.

Richmond Rice Rat.

Oryzomys richmondi Merriam, Proc. Washington Acad. Sci., III, p. 284, July 26, 1901.

Type locality.—Escondido River (50 miles above Bluefields), Nicaragua.

Type.—No. $\frac{36340}{48705}$, ♂ adult, United States National Museum (Biological Survey collection); collected by Charles W. Richmond, June 21, 1892.

Geographic distribution.—Low river valleys of eastern Nicaragua; Humid Lower Tropical Zone.

General characters.—Size and proportions about as in *O. c. couesi;* color decidedly darker.

Color.—Similar to that of *O. c. couesi,* but decidedly darker, more regularly ochraceous-tawny, the back and upper part of sides more heavily darkened by admixture of black hairs; underparts light ochraceous-buff.

Skull.—As in *O. c. couesi.*

Measurements.—Type: Total length, 295; tail vertebræ, 150; hind foot, 33.5. Average of 10 adults (type and nine topotypes): 275.8 (255–295); 137 (124–151); 30.9 (29–33.5). *Skull* (average of 5 adults—type and 4 topotypes): Greatest length, 31.8 (31.2–33.3); zygomatic breadth, 16.9 (16.4–17.9); interorbital breadth, 5.1 (5–5.3); width of braincase, 11.7 (11–11.9); nasals, 12.3 (11.6–13); anterior palatine foramina, 6 (5.8–6.2); palatal bridge, 5.8 (5.7–5.9); upper molar series, 4.5 (4.3–4.6).

Remarks.—This form, the darkest of the *O. couesi* series, is known only from low elevations in eastern Nicaragua, where Richmond found it inhabiting banana plantations. Although much darker in general tone of upperparts than most examples of *O. c. couesi* from adjacent territory, close agreement in all other important respects points to complete intergradation with the latter.

Specimens examined.—Total number, 35, as follows:

Nicaragua: Escondido River (50 miles above Bluefields, 12[a] [type and topotypes]; 45 miles above Bluefields, 18; 40 miles above Bluefields, 3; 25 miles above Bluefields, 1; 16 miles above Bluefields, 1).

ORYZOMYS COUESI ZYGOMATICUS Merriam.

Guatemalan Rice Rat.

Oryzomys zygomaticus Merriam, Proc. Washington Acad. Sci., III, p. 285, July 26, 1901.

Type locality.—Nenton, Guatemala (altitude 3,000 feet).

Type.—No. 76794, ♂ adult United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, December 15, 1895.

Geographic distribution.—Known only from the Chiapas River valley in southwestern Guatemala and south-central Chiapas; Arid Lower Tropical Zone.

General characters.—Closely resembling *O. c. couesi* and *O. c. mexicanus*, but upperparts slightly paler than in the former and slightly darker than in the latter.

Color.—About as in *O. c. couesi* but averaging slightly paler, the general tone ochraceous-buff as in the palest examples of *O. c. couesi;* underparts nearly pure white in the type, varying to light buff in other examples.

Skull.—As in *O. c. couesi.*

Measurements.—Type: Total length, 290; tail vertebræ, 152; hind foot, 33. *Skull* (type): Greatest length, 30.9; zygomatic breadth, 26.9; interorbital breadth, 4.8; width of braincase, 11.6; nasals, 11.6; anterior palatine foramina, 6; palatal bridge, 5.9; upper molar series, 4.6.

Remarks.—*O. c. zygomaticus* seems to be a slightly differentiated and rather localized form intermediate in color and geographic position between *O. c. couesi* and *O. c. mexicanus.* It doubtless intergrades directly with *couesi*, the type of which came from a higher elevation about 100 miles to the eastward in central Guatemala. Three specimens from Jacaltenango, at about 5,500 feet altitude, only a few miles to the southeast, are appreciably darker in color and seem to represent typical *couesi.* Near the Pacific Coast in southwestern Chiapas, *zygomaticus* doubtless passes into *mexicanus*, which differs mainly in having slightly paler color.

Specimens examined.—Total number, 5, as follows:

Chiapas: Ocuilapa, 1.
Guatemala: Nenton, 4 (type and topotypes).

ORYZOMYS COUESI MEXICANUS Allen.

Mexican Rice Rat.

Oryzomys mexicanus Allen, Bull. Amer. Mus. Nat. Hist., IX, p. 52, March 15, 1897.

Oryzomys bulleri Allen, Bull. Amer. Mus. Nat. Hist., IX, p. 53, March 15, 1897. Type from Valle de Banderas, Tepic, Mexico, No. [illegible], ♂ subad., Amer. Mus. Nat. Hist.; collected by Audley C. Buller, February 2, 1893.

Oryzomys rufus Merriam, Proc. Washington Acad. Sci., III, p. 287, July 26, 1901. Type from Santiago, Tepic, Mexico (altitude 200 feet). No. 91404, ♀ old, U. S. Nat. Mus. (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, June 20, 1897.

Type locality.—Hacienda San Marcos, Tonila, Jalisco, Mexico (altitude 3,500 feet).

Type.—No. $\frac{2650}{2128}$, ♂ adult, American Museum of Natural History; collected by Audley C. Buller, December 30, 1889.

Geographic distribution.—Pacific coastal plains and basal mountain slopes from southern Sinaloa to southeastern Oaxaca, Mexico; altitudinal range from sea level to about 1,000 feet (rarely to 3,500 feet), mainly in Arid Lower Tropical Zone.

General characters.—Size and proportions about as in *O. c. couesi;* color of upperparts rather decidedly paler, more ochraceous-buffy; underparts usually white, but varying to light buff, or light ochraceous-buff, the normal shades in *couesi.* Slightly paler than *O. c. zygomaticus;* slightly darker than *O. c. aztecus*, with smaller molar teeth. Similar in color to *O. c. albiventer*, but size smaller, and skull differing in detail.

Color.—*Fresh pelage:* Upperparts in general varying shades of ochraceous-buff, more or less suffused with tawny in old adults, becoming warm buff on cheeks, shoulders, and along lower parts of sides; the face, top of head, and back moderately darkened by blackish hairs; underparts usually nearly pure white, but varying to light buff; outer sides of ears dusky, the inner sides clothed with grayish or rusty reddish hairs; feet white; tail brownish above, dull yellowish below on proximal portion, becoming light brownish toward tip. *Young* (in first pelage): Upperparts near tawny-olive, the general tone darker and duller than in adults.

Skull.—About as in *O. c. couesi.* Differing from those of *O. c. aztecus*, *O. c. regillus*, and *O. c. albiventer* most noticeably in smaller size of molar teeth, the toothrows being correspondingly shortened.

Measurements.—Average of 10 adults from Escuinapa, Sinaloa: Total length, 251.4 (239–273); tail vertebræ, 137.4 (127–165); hind foot, 28.9 (27–35). *Skull* (average of same): Greatest length, 31.2 (29.8–33); zygomatic breadth, 17 (16.1–17.8); interorbital breadth, 4.8 (4.5–5.3); width of braincase, 11.6 (11.3–12.2); nasals, 12.2 (11.1–13.4); anterior palatine foramina, 6.1 (5.8–6.7); palatal bridge, 5.5 (4.8–6); upper molar series, 4.4 (4.2–4.8).

Remarks.—The narrow distribution area of *O. c. mexicanus* along the west coast of Mexico somewhat parallels that of *O. c. couesi* along the east coast; and as in that form, wide range of individual variation in size and color has resulted in the publication of names which appear to be based on unstable characters. While individuals vary notably in size and contour, as shown by every large series, skulls of *mexicanus* and *couesi* seem indistinguishable, their general characters being maintained with remarkable uniformity throughout the combined ranges of the two forms. Intergradation of *mexicanus* with *couesi* seems to be indicated by specimens from the Isthmus of Tehuantepec, and with *O. c. aztecus* by examples from the valley of the Balsas River in Guerrero.

Specimens examined.—Total number, 106, as follows:

Colima: Armeria, 11; Hacienda Magdalena, 2.
Guerrero: Ometepec, 7.
Jalisco: Hacienda San Marcos, 1 (type).[1]
Michoacan: La Huacana, 5.
Oaxaca: Huilotepec, 2; Juchitan, 1; Llano Grande, 5; Pluma, 3; Puerto Angel, 8; Reforma, 1;[2] Santa Efigenia, 1; Tehuantepec, 1.
Sinaloa: Escuinapa, 47;[1] Mazatlan, 1;[3] Rosario, 2.[4]
Tepic: San Blas, 4; Santiago, 2 (including type of "*rufus*"); Valle de Banderas, 2 (including type of "*bulleri*").

ORYZOMYS COUESI AZTECUS MERRIAM.

AZTEC RICE RAT.

Oryzomys crinitus aztecus Merriam, Proc. Washington Acad. Sci., III, p. 282, July 26, 1901.

Type locality.—Yautepec, Morelos, Mexico (altitude 4,000 feet).

Type.—No. 51173, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 16, 1893.

Geographic distribution.—Interior river valleys of Morelos, southern Puebla, northern Oaxaca, and northeastern Guerrero, Mexico; altitudinal range from about 3,000 to at least 4,000 feet in Arid Lower Tropical Zone.

General characters.—A pale form with white underparts and rather heavy dentition. Closely resembling *O. c. mexicanus*, but paler in color and with heavier dentition than usual in that subspecies. Differing from *O. c. crinitus* in paler upperparts, white instead of buffy underparts, and in cranial details.

Color.—As in the paler examples of *O. c. mexicanus*, the prevailing tone beneath the dark hairs on the back pale ochraceous-buff; underparts nearly pure white.

Skull.—About like that of *O. c. mexicanus*, but molar teeth larger. Similar to that of *O. c. crinitus*, but braincase narrower and molars slightly smaller.

Measurements.—Type: Total length, 290; tail vertebræ, 154; hind foot, 35. Two adults from Puente de Ixtle, Morelos: 318, 313; 160, 170; 34, 33. *Skull* (type): Greatest length, 32.4; zygomatic breadth, 17; interorbital breadth, 5.2; width of braincase, 12.2; nasals, 12.9; anterior palatine foramina, 6.4; palatal bridge, 6.2; upper molar series, 5.

Remarks.—*O. c. aztecus* is the palest form of the *O. couesi* series, but the light ochraceous tone of the upperparts is very closely approached by the paler examples of *O. c. mexicanus*, *O. c. albiventer*, and *O. c. aquaticus*. Specimens from the valley of the Balsas River in Guerrero and from northern Puebla approach *mexicanus* in dentition, as well as color, and might with nearly equal propriety be referred to that subspecies. The characters separating *aztecus* and *O. c. crinitus* are rather slight, as indicated in the original descriptions, and it seems best to regard both as forms of *O. couesi*.

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[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Field Mus. Nat. Hist.
[3] Collection Mus. Comp. Zool.
[4] One in collection Mus. Comp. Zool.

Specimens examined.—Total number, 20, as follows:

Guerrero: Balsas, 1;[1] Tlalixtaquilla, 1.
Morelos: Cuernavaca, 1; Puente de Ixtle, 6;[2] Yautepec, 5 (type and topotypes).
Oaxaca: Cuicatlan, 2.
Puebla: Piaxtla, 4.

ORYZOMYS COUESI CRINITUS MERRIAM.

VALLEY OF MEXICO RICE RAT.

Oryzomys crinitus Merriam, Proc. Washington Acad. Sci., III, p. 281, July 26, 1901.

Type locality.—Tlalpam, Federal District, Mexico (altitude 7,500 feet).

Type.—No. 50182, ♂ subadult (molars unworn), United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, November 30, 1892.

Geographic distribution.—Known only from type locality, at about 7,500 feet altitude in the Valley of Mexico; Upper Sonoran Zone.

General characters.—A large, moderately dark form with light buffy underparts and heavy dentition. Similar to *O. c. aztecus* and *O. c. albiventer*, but upperparts darker than either and underparts buffy instead of white; differing also in cranial details.

Color.—Very similar to that of *O. c. mexicanus*, but general tone of upperparts slightly darker; underparts light buffy as in some examples of *mexicanus*.

Skull.—Rather large with broad braincase and heavy dentition. Very similar to those of *O. c. aztecus*, *O. c. albiventer*, and *O. c. regillus*, but frontal region usually broader posteriorly; dentition about the same; interparietal rather large.

Measurements.—Type: Total length, 307; tail vertebræ, 161; hind foot, 37. Adult topotype: 280; 148; 35. *Skull* (type): Greatest length, 32.4; zygomatic breadth, 17; interorbital breadth, 5; width of braincase, 12.3; nasals, 12.4; anterior palatine foramina, 6.7; palatal bridge, 5.7; upper molar series, 4.9.

Remarks.—In the vicinity of marshes along the southern border of the Valley of Mexico, *O. c. crinitus* occurs at about 7,500 feet, the highest altitude attained by any known member of the *O. couesi* section of the genus. The exact relationship of this form to *O. fulgens* remains to be determined, since it possesses some of the characters ascribed to the latter species, the exact habitat of which is unknown. It is closely allied to the other forms inhabiting river valleys of the plateau region of Mexico—*O. c. aztecus*, *O. c. albiventer*, and *O. c. regillus*.

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[1] Collection Field Mus. Nat. Hist.

[2] Three in collection Field Mus. Nat. Hist.

Specimens examined.—Three, from type locality.

ORYZOMYS COUESI REGILLUS Goldman.

Michoacan Rice Rat.

(Pl. I, figs. 4, 4a.)

Oryzomys couesi regillus Goldman, Proc. Biol. Soc. Washington, XXVIII, p. 129, June 29, 1915.

Type locality.—Los Reyes, Michoacan, Mexico.

Type.—No. 125945, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 17, 1903.

Geographic distribution.—Plateau region of northwestern Michoacan, Mexico; altitudinal range from about 3,000 to 4,000 feet, mainly in Arid Lower Tropical Zone.

General characters.—A large form closely allied to *O. c. albiventer;* upperparts darker, more rufescent in color. Similar in general to *O. c. mexicanus*, but larger and richer colored; cranial details also distinctive.

Color.—Much as in *O. c. mexicanus* and *O. c. albiventer* but upperparts darker and more rufescent, the general tone rich ochraceous-buff, the back and rump strongly suffused with tawny and lined with black hairs as usual in the group; underparts varying from nearly pure white to light buff.

Skull.—Like that of *O. c. albiventer;* similar to those of *O. c. mexicanus* and *O. c. couesi*, but larger, with broader braincase and heavier dentition.

Measurements.—Type: Total length, 305; tail vertebræ, 169; hind foot, 36. Average of three adult topotypes: 308 (285–320); 168 (155–180); 35 (34–36). *Skull* (average of 4 adults—type and 3 topotypes): Greatest length, 33.1 (32.5–33.5); zygomatic breadth, 18.1 (17.5–18.5); interorbital breadth, 4.9 (4.6–5.3); width of braincase, 12.5 (12.4–12.5); nasals, 12.9 (12.5–13.3); anterior palatine foramina, 6.2 (6–6.5); palatal bridge, 6.5 (6.4–6.6); upper molar series, 5.1 (4.9–5.3).

Remarks.—This handsome rice rat differs only in color from its near geographic neighbor, *O. c. albiventer*, and the two doubtless intergrade in northern Michoacan.

Specimens examined.—Total number, 13, as follows:

Michoacan: Los Reyes, 11 (type and topotypes); Querendaro, 1; Zamora, 1.

ORYZOMYS COUESI ALBIVENTER Merriam.

White-Bellied Rice Rat.

Oryzomys albiventer Merriam, Proc. Washington Acad. Sci., III, p. 279, July 26, 1901.
Oryzomys molestus Elliot, Field Columb. Mus., publ. 71, zool. ser., III, p. 145, February, 1903. Type from Ocotlan, Jalisco, Mexico (altitude 5,000 feet). No. 8667, ♂ old, Field Mus. Nat. Hist.; collected by F. E. Lutz, June, 1901.

Type locality.—Ameca, Jalisco, Mexico (altitude 4,000 feet).

Type.—No. 82236, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 6, 1897.

Geographic distribution.—River valleys of the plateau region in central Jalisco, Mexico; altitudinal range from about 4,000 to 5,000 feet mainly in Lower Sonoran Zone.

General characters.—Color about as in *O. c. mexicanus*, but size usually larger and cranial details distinctive. Similar in size and proportions to *O. c. regillus* and *O. c. crinitus*, but paler than either, the upperparts lacking the rich rufescent tone of the former, and the underparts normally white instead of buffy as in the latter.

Color.—About as in *O. c. mexicanus*, underparts normally white, but varying to pale, creamy buff.

Skull.—About like that of *O. c. regillus;* similar to that of *O. c. crinitus*, but frontal region usually narrower posteriorly. Compared with those of *O. c. couesi* and *O. c. mexicanus* the skull is decidedly broader, with heavier dentition.

Measurements.—Type: Total length, 288; tail vertebræ, 153; hind foot, 37.5. Average of 10 adults (type and 9 topotypes): 294 (276–314); 161 (151–173); 36.6 (34–40). *Skull* (average of 10 adults—type and 9 topotypes): Greatest length, 33.1 (31.5–34.4); zygomatic breadth, 17.9 (17.3–18); interorbital breadth, 4.8 (4.1–5.2); width of braincase, 12.3 (11.5–12.8); nasals, 13 (12.3–14.2); anterior palatine foramina, 6.3 (5.9–6.6); palatal bridge, 6.3 (5.8–6.7); upper molar series, 5.3 (5–5.5).

Remarks.—While *O. c. albiventer* is usually larger in general size, with broader skull and decidedly larger molar teeth than *O. c. mexicanus*, occasional examples of the two forms are difficult to distinguish and point to probable intergradation in western Jalisco. "*Oryzomys molestus*" of Elliot is based on an unusually large old adult which is clearly referable to *albiventer*, as are four examples in the Biological Survey collection from the same locality.

Specimens examined.—Total number, 18, as follows:

Jalisco: Ameca, 12 (type and topotypes); La Barca, 1; Ocotlan, 5 (including type of "*molestus.*")[1]

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[1] Collection Field Mus. Nat. Hist.

ORYZOMYS COUESI PERAGRUS Merriam.

Rio Verde Rice Rat.

Oryzomys mexicanus peragrus Merriam, Proc. Washington Acad. Sci., III, p. 283, July 26, 1901.

Type locality.—Rio Verde, San Luis Potosi, Mexico.

Type.—No. 82119, ♂ subadult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 8, 1897.

Geographic distribution.—Known only from type locality, at about 3,000 feet altitude on the Rio Verde River, in southern San Luis Potosi; Lower Sonoran Zone.

General characters.—Closely allied to *O. c. couesi* but slightly larger, with upperparts more pinkish instead of ochraceous-buffy in general tone; skull more massive. Similar to *O. c. aquaticus* but upperparts usually darker, the ground color less ochraceous-buffy and the dorsal area more heavily lined with black.

Color.—Similar to that of *O. c. couesi* but upperparts paler, less ochraceous-buffy, the cheeks, shoulders, and sides near pinkish buff; lips and chin whitish.

Skull.—About like that of *O. c. aquaticus*; larger and more massive than that of *O. c. couesi*, with broader braincase and broader interorbital space.

Measurements.—Type: Total length, 294; tail vertebræ, 167; hind foot, 35. Average of 2 adult topotypes: 274 (265–283); 151 (143–160); 33.5 (33–34). *Skull* (average of 3 adults—type and 2 topotypes): Greatest length, 31.5 (31–32.2); zygomatic breadth, 16.6 (16.1–17.1); interorbital breadth, 5.5 (5.4–6.2); width of braincase, 12.1 (12–12.3); nasals, 12.1 (11.8–12.5); anterior palatine foramina, 5.8 (5.7–5.8); palatal bridge, 5.9 (5.7–6.2); upper molar series, 4.9 (4.7–5).

Remarks.—As nearly as can be determined by the three known specimens, all young adults, *O. c. peragrus* is somewhat intermediate in characters, as well as geographic position, between *O. c. couesi* and *O. c. aquaticus.* It differs in color from both, but in cranial details approaches the latter form.

Specimens examined.—Three, from type locality.

ORYZOMYS COUESI AQUATICUS Allen.

Rio Grande Rice Rat.

(Pl. I, figs. 5, 5a.)

Oryzomys aquaticus Allen, Bull. Amer. Mus. Nat. Hist., III, p. 289, June 30, 1891.

Type locality.—Brownsville, Cameron County, Texas.

Type.—No. $\frac{3411}{2684}$, ♂ adult, American Museum of Natural History; collected by F. B. Armstrong, March 6, 1891.

Geographic distribution.—Rio Grande Valley, from Camargo, Tamaulipas, to Gulf coast near Brownsville, Texas; altitudinal range from sea level to about 300 feet in lower Sonoran Zone.

General characters.—Size large; closely resembling *O. c. peragrus* but upperparts usually paler, less pinkish, more ochraceous-buffy; underparts buffy, as in *peragrus*. Similar in general to *O. c. couesi* but larger; general color above paler ochraceous-buff; skull relatively broader and more massive.

Color.—*Fresh pelage:* Upperparts near ochraceous-buff, palest on cheeks, shoulders, and along sides; the face, top of head, and back obscured by dusky hairs; underparts varying from light buff to warm buff, becoming in some specimens more or less distinctly whitish on lips, chin, and throat; feet whitish; tail brownish above, pale yellowish below, becoming pale brownish toward tip. *Young* (in first pelage): Upperparts near tawny-olive; underparts with a pale buffy wash, the plumbeous basal color of the fur showing through.

Skull.—About like that of *O. c. peragrus;* decidedly larger and heavier throughout than that of *O. c. couesi*, with broader braincase and more widely spreading zygomata; ascending branches of premaxillæ exhibiting a tendency to exceed nasals in posterior extent (nasals usually exceeding premaxillæ in forms of *O. couesi*).

Measurements.—Type: Total length, 286; tail vertebræ, 140; hind foot, 31.2 (dry skin). Average of 5 adult topotypes: 297 (283–310); 161 (138–180); 34.5 (32–38). *Skull* (average of same): Greatest length, 33 (32–35.4); zygomatic breadth, 18 (16.7–18.8); interorbital breadth, 5 (4.7–5.2); width of braincase, 12 (11.6–12.7); nasals, 12.7 (11.6–13.8); anterior palatine foramina, 6.3 (6.1–6.6); palatal bridge, 6 (5.4–6.6); upper molar series, 5.1 (4.8–5.3).

Remarks.—The Rio Grande Valley, inhabited by *O. c. aquaticus*, marks the extreme northern limit of the general range of the *O. couesi* series. No rice rats are yet known from the interval of coastal plain in Tamaulipas, but close resemblance in all essential respects points to intergradation through *O. c. peragrus* with typical *couesi*. In general size and contour the skull of aquaticus is not widely different from those of *O. c. albiventer*, *O. c. regillus*, and *O. c. crinitus* of the Mexican plateau region, but it maintains the lighter dentition of typical *couesi*.

Specimens examined.—Total number, 41, as follows:

Texas: Brownsville, 37 (type and topotypes);[1] Lomita Ranch (Hidalgo County), 1.

Tamaulipas: Camargo, 1; Matamoros, 2.

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[1] Fourteen in Amer. Mus. Nat. Hist.; 3 in Kansas Univ. Mus.; 2 in Field Mus. Nat. Hist.; 2 in Mus. Comp. Zool.; 2 in Acad. Nat. Sci. Philadelphia.

ORYZOMYS FULGENS Thomas.

Thomas Rice Rat.

Oryzomys fulgens Thomas, Ann. Mag. Nat. Hist., ser. 6, XI, p. 403, May, 1893.

Type locality.—"Mexico." Southern Mexico, exact locality unknown (probably in or near Valley of Mexico).

Type.—70.6.20.3, ♂ adult, British Museum; purchased of Geale, collected by A. Boucard.

Geographic distribution.—Range unknown.

General characters.—From original description: "Size large. Fur very thick, coarse and woolly. General colour above bright fulvous, brighter than in any other Central-American species; anterior half of the body, including the head, rather paler and duller than the posterior half. Ears decidedly small, broadly rounded, thinly haired, their hairs practically the same colour as those of the head in general, so that they are not distinguishable by colour at a distance. Lips, chin, throat, and inguinal region whitish, belly with a strong suffusion of fawn, which reaches a maximum on the breast between the fore legs; passage of upper colour into lower quite gradual. Outer sides of limbs like back, inner sides whitish; upper surfaces of hands and feet thinly clothed with pale silvery-fawn hairs. Tail long, thinly haired, the scales not hidden by the hairs; above blackish, below yellowish, darkening towards the tip."

Skull.—From original description: "Skull readily distinguishable from all allied species by its great breadth, the bold expansion of the zygomata, and especially by the evenly incurved outline of the supraorbital edges; in all other species these edges form two approximately straight lines diverging from the narrowest interorbital point, but in *O. fulgens* the whole inner wall of the orbit forms one even curve, the breadth at the posterior end of the olfactory chamber being scarcely greater than at the anterior end. Nasals broad and flattened. Frontal premaxillary processes very narrow and barely attaining to the same level as the back of the nasals. Anterior palatine foramina large, widely open, their posterior margin just level with the front of *m1*."

Measurements.—Dry skin of type (from original description): Head and body, 160; tail, 151; hind foot, 37.5 (c. u.). *Skull* (type): Upper length,[1] 31.8; zygomatic breadth, 17.8 (c.); nasals, 13.2; interorbital breadth, 4.8; diastema, 9.1; anterior palatine foramina, 7.2; upper molar series, 5.2.

Remarks.—The type of *O. fulgens* I have been unable to examine, and none of the more recently accumulated material from Mexico can at present be assigned with certainty to that species. Thomas's full description, above quoted, and comparisons kindly made for me by W. H. Osgood, however, seem to indicate that this is a member of the widely dispersed *O. couesi* section of the genus. Some of the characters given are shared in common by various forms now recognized. In size and color arrangement it closely approaches *O. c. crinitus*, of the Valley of Mexico, and may be identical with that form, but the intensity of color and details presented by the incomplete skull, especially the form of the interorbital region, appear to be distinctive and the exact position of *fulgens* remains to be determined.

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[1] To back of parietal suture only.

ORYZOMYS GATUNENSIS GOLDMAN.

GATUN RICE RAT.

(Pl. I, figs. 6, 6a.)

Oryzomys gatunensis Goldman, Smiths. Misc. Coll., LVI, no. 36, p. 7, February 19, 1912.

Type locality.—Gatun, Canal Zone, Panama.

Type.—No. 171034, ♂ young (about two-thirds grown), United States National Museum (Biological Survey collection); collected by E. A. Goldman March 7, 1911.

Geographic distribution.—Known only from type locality, near sea level; Humid Lower Tropical Zone.

General characters.—A dark-colored form externally similar to *O. c. richmondi*, but with distinctive cranial characters.

Color.—*Fresh pelage:* Upperparts near ochraceous-tawny, palest on cheeks, shoulders, and along sides; the face, top of head, and back much darker by admixture of black hairs; underparts light ochraceous-buffy; outer sides of ears blackish, the inner sides clothed with ochraceous-buffy hairs; feet thinly covered with very short whitish or grayish hairs; tail light brownish above, somewhat paler below.

Skull.—Similar in general to that of *O. c. richmondi*, but frontal region broader, the lateral margins more developed as supraorbital shelves; interparietal much less extended antero-posteriorly; nasals more prolonged posteriorly beyond premaxillæ; dentition about as in *richmondi*.

Measurements.—Type: Total length, 224; tail vertebræ, 115; hind foot, 31.5. *Skull* (type): Greatest length, 27.7; zygomatic breadth, 14.5; interorbital breadth, 5.3; width of braincase, 11.4; nasals, 10.2; anterior palatine foramina, 5.6; palatal bridge, 5.2; upper molar series, 5.

Remarks.—This species requires comparison with only *O. c. richmondi*, with which it is nearly identical in color and general external appearance. The skull, however, differs in apparently important respects from those of all the forms of *O. couesi*. Especially noticeable is the lateral development of the supraorbital ridges, a character which in fully adult examples would doubtless be more pronounced; the reduced antero-posterior extent of the interparietal seems to be another distinguishing feature. On the other hand the material representing *O. gatunensis* is scanty and the range of individual variation being undetermined, intergradation with *couesi* and *richmondi* in Costa Rica or western Panama seems not improbable.

Specimens examined.—Two, from type locality.

ORYZOMYS COZUMELÆ MERRIAM.

COZUMEL RICE RAT.

(Pl. I, figs. 7, 7a.)

Oryzomys cozumelæ Merriam. Proc. Washington Acad. Sci., III, p. 280, July 26, 1901.

Type locality.—Cozumel Island, off east coast of Quintana Roo, Mexico.

Type.—No. 108462, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, April 8, 1901.

Geographic distribution.—Known only from type locality.

General characters.—Size large; tail much longer than head and body; color dark. A large species allied to *O. c. couesi* of the neighboring mainland, differing in larger size, darker color, and proportionately longer tail.

Color.—*Worn pelage:* Upperparts between ochraceous-tawny and cinnamon-brownish, palest on cheeks, shoulders, and sides, darkened on face, top of head, and back by a brownish admixture; underparts between light buff and light ochraceous-buff; feet whitish; tail dark brownish above, dull yellowish below basally, becoming dusky all around toward tip.

Skull.—In general outline closely resembling that of *O. c. couesi* but larger and more massive; rostrum and anterior roots of zygomata relatively slightly heavier; dentition about as in *couesi*.

Measurements.—Type: Total length, 332; tail vertebræ, 182; hind foot, 35. Average of 6 adult topotypes: 306 (285–327); 172 (163–177); 34.3 (33–35.5). *Skull* (average of 6 adults—type and 5 topotypes): Greatest length, 32 (30.5–34.4); zygomatic breadth, 16.9 (15.9–17.9); interorbital breadth, 5 (4.7–5.6); width of braincase, 12.1 (11.5–12.6); nasals, 12.5 (11.7–13.6); anterior palatine foramina, 6.3 (6.2–6.7); palatal bridge, 5.8 (5.7–6.1); upper molar series, 5 (4.8–5.3).

Remarks.—This insular species is clearly an offshoot of *O. couesi*, the widely ranging mainland form. Its divergence from typical *couesi* is mainly in the direction of larger general size and the development of a relatively longer tail.

Specimens examined.—Nine, from type locality.

ORYZOMYS ANTILLARUM Thomas.

Jamaican Rice Rat.

Oryzomys antillarum Thomas, Ann. Mag. Nat. Hist., ser. 7, I, p. 177, February, 1898.

Type locality.—Jamaica.

Type.—No. 45.10.25.48, British Museum; collected by P. H. Gosse.

Geographic distribution.—Known only from Jamaica.

General characters.—Allied to *O. couesi;* size and proportions about as in the typical subspecies; color apparently similar; skull differing in rather slight details.

Color.—From original description of type: "General colour dull rufous, rather (though not prominently) richer on the rump and greyer on the head; black lining of back not prominently marked. Belly dull yellowish, not sharply defined, the hairs slaty grey basally. No blackish ring round eyes. Ears small, their visible external surface blackish and internal yellowish, but in neither case very strongly contrasting with the general colour. Hands and feet dull whitish above. Tail apparently about as long as head and body, very thinly haired, almost naked, pale brownish above, rather lighter below." Two specimens in the United States National Museum, collected many years ago, are very tawny above, but appear to have been immersed in alcohol, and the naturally ruddy tone thereby intensified.

Skull.—Closely resembling that of *O. c. couesi*, but nasals reaching farther posteriorly beyond premaxillæ (nasals and premaxillæ more nearly conterminous in *couesi*); maxillary arm of zygoma heavier; anterior palatine foramina shorter than usual in *couesi;* dentition about the same.

Measurements.—From original description of type (measured in skin): "Head and body (apparently stretched) 130 millim.; tail (imperfect at tip) 130; hind foot without claws (moistened), 28." * * * Skull (type): "Basal length (c.) 26, basilar length (c.) 24; greatest breadth 17; nasals 12.6 x 4.1; interorbital breadth 5.2; breadth of braincase on squamosals 12.9; interparietal 2.8 x 8.5; palate length from henselion 14; diastema 8.3; palatal foramina 5.7 x 2.1; length of upper molar series 4.6". An adult from Metcalfe Parish (dry skin): Total length, 252; tail vertebræ, 122; hind foot (c. u.), 29.2. *Skull* (of same): Greatest length, 30.5; zygomatic breadth, 16.6; interorbital breadth, 5.1; width of braincase, 12.2; nasals, 12.6; anterior palatine foramina, 5.7; upper molar series, 4.5.

Remarks.—The relationship of the Jamaican rice rat to *O. couesi* was pointed out by Thomas in his original account of the species. In view of its isolation, the general agreement in all the more important respects, even to size, a character usually subject to modification in insular forms, is remarkable, and suggests the possibility that *O. antil-*

larum may have been transported from some point on the coast of the North American mainland within a comparatively recent period. As suggested by Thomas, however, the fact that no specimens appear to have been taken since 1877, while rats of the Old World have devastated the island, to be persecuted in their turn by the mongoose, introduced in 1872, renders it probable that the rice rat has been exterminated there.

Specimens examined.—Total number, 2, as follows:

Jamaica: Metcalfe Parish, 1; Spanishtown, 1.

ORYZOMYS PENINSULÆ Thomas.

Lower California Rice Rat.

(Pl. I, figs. 8, 8a.)

Oryzomys peninsulæ Thomas, Ann. Mag. Nat. Hist., ser. 6, XX, p. 548, December, 1897.

Type locality.—Santa Anita, Lower California, Mexico.

Type.—Male adult, British Museum.

Geographic distribution.—Known only from very limited marshy areas near sea level in extreme southern Lower California; Arid Lower Tropical Zone.

General characters.—General size and proportions about as in *O. c. mexicanus;* color similar, but anterior part of body, especially head and shoulders, strongly suffused with gray; skull rather broad, with squarely spreading zygomata and large interparietal.

Color.—*Fresh pelage:* Upperparts between warm buff and pale ochraceous-buff (more or less distinctly tawny in worn pelage of old adults) most intense on rump, becoming light buffy grayish on head, fore limbs, shoulders, and sides; underparts overlaid with white, the basal color of the fur usually plumbeous, except on chin and throat, where it is pure white to roots; outer sides of ears brownish, inner sides clothed with grayish or ochraceous-buffy hairs; feet white; tail light brownish above, yellowish below, becoming more or less distinctly brownish toward tip. *Young* (in first pelage): Upperparts more fuscous, the head and shoulders lacking the grayish suffusion so noticeable in adults; underparts dull buffy or soiled white, becoming pure white on chin and throat.

Skull.—Similar to that of *O. c. mexicanus*, but broader; zygomata more widely and squarely spreading; braincase less flattened, higher, more rounded or inflated; interparietal larger; anterior palatine foramina much broader, more widely open; lateral wings of parietals extending farther below temporal ridges at expense of squamosals; ascending branches of premaxillæ usually reaching posteriorly beyond nasals (nasals usually exceeding premaxillæ in posterior extent in *mexicanus*).

Measurements.—Average of nine adults from San Jose del Cabo, Lower California (near type locality): Total length, 283 (270–305); tail vertebræ, 143 (138–156); hind foot, 32.2 (31.5–34). *Skull* (average of eight adults from San Jose del Cabo, Lower California): Greatest length, 32.5 (31.5–33.9); zygomatic breadth, 17.9 (17.1–19); interorbital breadth, 5.1 (4.9–5.3); width of braincase, 12 (11.4–12.2); nasals, 13 (12.6–13.4); anterior palatine foramina, 6.6 (6.2–7.4); palatal bridge, 6.2 (6–6.4); upper molar series, 4.8 (4.7–5.1).

Remarks.—*O. peninsulæ* is allied to *O. c. mexicanus* of the adjacent mainland coast of Mexico, but important differential cranial characters are numerous. The range of the species seems to be centered in the marshes near the mouth of the San Jose River at San Jose del Cabo, extending a few miles inland along the course of the stream. The neighboring coast is extremely arid and unsuitable for habitation by an *Oryzomys*.

Specimens examined.—Total number, 16, as follows:

Lower California: San Jose del Cabo, 15; Santa Anita, 1 (topotype).

ORYZOMYS NELSONI MERRIAM.

NELSON RICE RAT.

(Pl. II, figs. 1, 1a.)

Oryzomys nelsoni Merriam, Proc. Biol. Soc. Washington, XII, p. 15, January 27, 1898.

Type locality.—Maria Madre Island, Tres Marias Islands, off coast of Tepic, western Mexico (altitude 800 feet).

Type.—No. 89200, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, May 13, 1897.

Geographic distribution.—Known only from type locality, Maria Madre Island, where it inhabits moist places on the upper slopes at about 800 feet altitude; Arid Lower Tropical Zone.

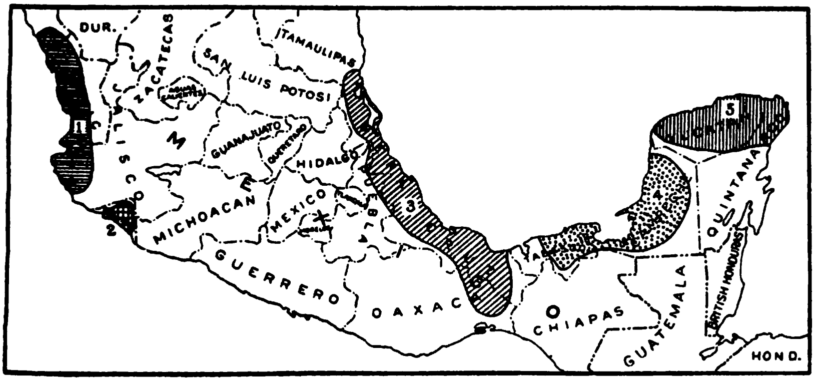
General characters.—Size very large; tail much longer than head and body; color of upper parts rich ochraceous-buff; skull rather long and narrow, but massive. Allied to *O. c. mexicanus*, but differing widely in details of structure.

Color.—*Fresh pelage:* Upperparts rich ochraceous-buff, most intense on rump, paling to warm buff on head, shoulders, and lower parts of sides; somewhat darkened on face, top of head, and back by dusky hairs; underparts white; outer and inner sides of ears thinly clothed with grayish hairs; tail light brownish above and all round near tip, becoming yellowish below on basal portion.

Skull.—Massive, upper outline rising high over anterior roots of zygomata, the rostrum very heavy and strongly decurved. Somewhat similar in general to that of *O. c. mexicanus*, but much larger and heavier; rostrum much more swollen and decurved; zygomata heavier, but relatively less widely spreading, the sides more nearly parallel; supraorbital ridges less divergent posteriorly; interparietal larger; anterior palatine foramina relatively shorter; dentition about as in *mexicanus*.

Measurements.—Type: Total length, 324; tail vertebræ, 190; hind foot, 38. Two adult topotypes: 344, 320; 191, 185; 39, 37. *Skull* (average of 3 adults—type and 2 topotypes): Greatest length, 35.8 (34.5–37.8); zygomatic breadth, 18.7 (18.2–19); interorbital breadth, 5.4 (5.2–5.6); width of braincase, 12.9 (12.8–13. 1); nasals, 14.5 (14.2–14.8); anterior palatine foramina, 6.3 (6.1–6.7); palatal bridge, 6.9 (6.6–7.3); upper molar series, 5.3 (5.1–5.4).

Remarks.—The isolation of *O. nelsoni* on an island 70 miles off the mainland coast has resulted in the evolution of a well-marked species, but agreement in essential characters with forms of *O. couesi* places it in that widely distributed section of the genus. It differs strikingly from all the mainland forms in the remarkable development of the rostrum.



1. *O. m. melanotis.*
2. *O. m. colimensis.*
3. *O. r. rostratus.*
4. *O. r. megadon.*
5. *O. r. yucatanensis.*

FIG. 4.—Geographic distribution of the *Oryzomys melanotis* group.

Specimens examined.—Four, from type locality.

Oryzomys melanotis Group.

Geographic distribution—Mainly lower elevations near the Pacific coast of Mexico from southern Sinaloa to Colima, and along the gulf coast from southern Tamaulipas to the Yucatan peninsula; altitudinal range from sea level to about 3,000 feet; Arid and Humid Lower Tropical Zones (fig. 4).

General characters.—Size small, medium, or large; form rather slender; tail about same length as head and body or somewhat longer, scantily and indistinctly haired; ears large and conspicuous, thinly clothed externally with short, fine dusky hairs and internally with similarly short, rufescent hairs; general pelage short, rather harsh, and lacking the woolly quality of *O. palustris;* vibrissæ about as long as head; toes of hind feet more or less distinctly webbed at base, the three longest bearing tufts of silvery bristles which project beyond ends of claws; claws short, recurved, compressed, and sharp pointed. Color of upperparts varying from ochraceous-buff to rich ochraceous-tawny, lined with black; underparts white or buffy whitish.

Skull.—Size small, medium, or large, with rostrum long and braincase rather narrow; maxillary arm of zygoma heavy; outer wall of antorbital foramen with projecting border rounded or sloping forward, the antorbital fossa deep and conspicuous, but less evenly circular than in *O. palustris* as viewed from above; nasals and premaxillæ about conterminous posteriorly; frontal region wide or narrow, constricted near middle, the lateral margins ridged or smooth; temporal ridges moderately developed anteriorly along parieto-squamosal sutures, becoming indistinct posteriorly in crossing lateral wings of parietals; interparietal large; anterior palatine foramina short and broad, much shorter than palatal bridge, not normally reaching anterior plane of first molars; palatal pits and spheno-palatine vacuities large; interpterygoid fossa broad; audital bullæ small, the inner sides extensively overlapped by mastoids; basi-occipital broad; angle of mandible broad, the inferior border strongly turned inward; coronoid process short and low, owing largely to high, thin commissural border extending to condyle; molars small, approaching the *O. palustris* type but smaller, second upper molar more evenly cleft by inner reentrant angle, and third lower molar more deeply incised by outer reentrant angle. The skulls of *O. melanotis* and its allies differ from those of the *O. palustris* group most noticeably in the elongation of the rostrum, shortness of anterior palatine foramina in relation to palatal bridge, small size of audital bullæ, and the dental details noted.

Remarks.—Unlike *O. palustris* and its allies, which live on the ground mainly in open marshy places or resort to the vicinity of water, members of this group favor more forested areas, where they are partially scansorial in habits, and occur on well-drained but moist mountain slopes sometimes at points distant from water.

In external appearance, forms of the *O. melanotis* group superficially resemble those of *O. couesi,* and the two often occur together at the same localities. In contrast with *O. couesi,* however, the upperparts are usually more rufescent, the ears are much larger, less conspicuously hairy, and tufts of silvery bristles project beyond the points of the three longer claws on the hind foot (claws reaching beyond bristles in *couesi*).

Key to Species and Subspecies of the O. melanotis Group.

a^1. Size larger; hind foot 30 or more. (Atlantic coast of Mexico [*O. rostratus*].)
  b^1. Upper molar series 4 or more.
    c^1. Color darker. (Tabasco; Campeche.)................ **O. r. megadon** (p. 54).
    c^2. Color paler. (Southern Tamaulipas; Vera Cruz; northern Puebla; northeastern Oaxaca.).................................. **O. r. rostratus** (p. 53).
  b^2. Upper molar series less than 4. (Yucatan.).........**O. r. yucatanensis** (p. 55).
a^2. Size smaller; hind foot less than 30. (Pacific coast of Mexico [*O. melanotis*].)
  b^1. Color darker. (Sinaloa; Tepic; Jalisco.)............ **O. m. melanotis** (p. 50).
  b^2. Color paler. (Colima.)............................ **O. m. colimensis** (p 51).

ORYZOMYS MELANOTIS Thomas.

[Synonymy under subspecies.]

Geographic distribution.—Pacific coastal plains and basal mountain slopes from southern Sinaloa south through western Tepic and Jalisco to Colima; altitudinal range from sea level to 3,000 feet; Arid Lower Tropical Zone.

General characters.—Size small or medium; general color above varying from rich ochraceous-buffy to pale ochraceous-tawny; similar to small forms of *O. rostratus* in general external appearance but skull differing in important details.

Color.—*Fresh pelage:* Upperparts varying from ochraceous-buff to pale ochraceous-tawny (sometimes becoming intense tawny or rusty reddish in the worn pelage of old adults), rather sparingly lined with black hairs, which becoming less numerous along cheeks and sides, leave them a purer, brighter color than the back; underparts pale buffy white, the dark basal color of the fur showing through; outer sides of ears blackish, the inner sides thinly clothed with rusty reddish hairs; a more or less conspicuous patch of light-colored fur under base of ear; feet (epidermis) dull yellowish, thinly covered above with short white hairs; tail (epidermis) brownish above, becoming light brownish or dull yellowish below except near lip, which is usually dark all around. *Young* (in first pelage): Upperparts duller and darker, the general tone browner than in adults.

Skull.—Similar in general to that of *O. rostratus*, but upper outline less elevated over anterior part of frontals; braincase relatively higher, the parietal region more expanded; rostrum more slender, less decurved; frontals broader, with narrow and delicate but rather well-developed supraorbital borders; parietals more squarely truncate anteriorly, the fronto-parietal sutures more widely divergent; temporal ridges tending to spread more widely posteriorly, rejoining squamosals after crossing slightly developed lateral wings of parietals; interparietal larger, with a less evident posterior angle; outer wall of antorbital foramen narrower, less extended anteriorly; anterior palatine foramina short and wide as in *rostratus;* dentition about the same.

Remarks.—Two closely allied geographic races of *O. melanotis* occupy a part of the arid coast region of western Mexico, where they appear to be completely isolated from their relatives (subspecies of *O. rostratus*) along the Gulf coast of eastern Mexico. The not very distant relationship of *O. melanotis* to *O. rostratus* is evidenced in numerous characters, but the two species appear to be distinct. In general external appearance, including color, they are much alike; in fresh pelage *O. melanotis* may usually be distinguished by the whitish subauricular spots; the skulls are easily separable by the characters pointed out.

ORYZOMYS MELANOTIS MELANOTIS Thomas.

Jalisco Rice Rat.

(Pl. II, figs. 2, 2a; Pl. V, fig. 5; Pl. VI, figs. 2, 2a.)

Oryzomys melanotis Thomas, Ann. Mag. Nat. Hist., ser. 6, XI, p. 404, May, 1893.

Type locality.—Mineral San Sebastian, Jalisco, Mexico.

Type.—93.3.6.25, ♂ old, British Museum; collected by Dr. Audley C. Buller, January 25, 1893.

Geographic distribution.—Coastal plains and basal mountain slopes in southern Sinaloa, Tepic, and Jalisco; altitudinal range from sea level to about 3,000 feet; Arid Lower Tropical Zone.

General characters.—Size medium; color of upperparts near pale ochraceous-tawny; closely allied to *O. m. colimensis* but larger and darker colored; externally similar to pale examples of *O. rostratus;* skull with long, slender rostrum and high-arched braincase.

Color.—*Fresh pelage:* Upperparts pale ochraceous-tawny (becoming intense tawny or rusty reddish in the worn pelage of old adults), rather sparingly lined with black hairs, which becoming less numerous along cheeks and sides leave them a purer, brighter color than on the back; underparts white or pale buffy white, the dark basal color of the fur showing through; outer sides of ears blackish, inner sides thinly clothed with rusty reddish hairs; a more or less conspicuous patch of whitish fur under base of ear; feet whitish; tail brownish above, becoming light brownish or yellowish below except near tip, which is usually dark all around. *Young* (in first pelage): Upperparts duller and darker, the general tone browner than in adults.

Skull.—Similar to that of *O. m. colimensis*, but larger, with comparatively smaller molar teeth.

Measurements.—Average of five adult topotypes: Total length, 235 (228–244); tail vertebræ, 128 (124–134); hind foot, 28.2 (27.5–29). *Skull* (two adult topotypes): Greatest length, 28.5, 27.9; zygomatic breadth, 14.4, 14.5; interorbital breadth, 4.8, 5.2; width of braincase, 10.8, 10.7; nasals, 11.5, 10.3; anterior palatine foramina, 4.3, 5.2; palatal bridge, 5.4, 5.4; upper molar series, 4, 4.3.

Remarks.—Specimens from localities near sea level in Jalisco and Tepic are larger than those from the type locality at 3,000 feet altitude on the slope of the mountains, and may represent a slightly different form. In size they contrast strongly with the small form *O. m. colimensis* inhabiting the coast of Colima.

Specimens examined.—Total number, 13, as follows:

Jalisco: Ixtapa, 2; San Sebastian, 6 (type and topotypes).
Sinaloa: Los Limones, 1.[1]
Tepic: San Blas, 2; Santiago, 2.

ORYZOMYS MELANOTIS COLIMENSIS, SUBSP. NOV.

COLIMA RICE RAT.

(Pl. II, figs. 3, 3a.)

Type locality.—Armeria, Colima, Mexico (altitude about 100 feet).

Type.—No. $\frac{33289}{45317}$, ♀ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson, March 2, 1892. Original number 1987.

Geographic distribution.—Forested coastal plains and basal mountain slopes in the State of Colima, Mexico; altitudinal range from sea level to 1,500 feet; Arid Lower Tropical Zone.

General characters.—A small form closely allied to *O. m. melanotis;* differing mainly in smaller size and paler color; general tone of upperparts ochraceous-buff instead of ochraceous-tawny as in *melanotis.*

Color.—Upperparts in general near ochraceous-buff, the top of head and back sparingly mixed with black, giving a lined effect; cheeks, shoulders, and sides paler than back, the general tone light ochraceous-buff; underparts whitish or pale buffy whitish; ears blackish or brownish, thinly clothed on outer sides with short dusky hairs, and on inner sides with buffy or rusty reddish hairs; a patch of whitish fur under base of ear as in *O. m. melanotis;* feet yellowish, thinly covered above with short white hairs; tail brownish above, yellowish below to near tip, which is dusky all around.

Skull.—About like that of *O. m. melanotis*, but smaller; molar teeth actually about the same size as those of *melanotis*, and therefore relatively larger.

Measurements.—Type: Total length, 216; tail vertebræ, 116; hind foot, 26. Adult topotype: 220; 118; 28. *Skull* (average of two adults, type and topotype): Greatest length, 27 (26.3–27.7); zygomatic breadth, 14 (13.9–14.2); interorbital breadth, 4.7 (4.5–4.9); width of braincase, 10.2 (9.9–10.6); nasals, 10.7 (10.3–11.1); anterior palatine foramina, 4.4 (4.3–4.5); palatal bridge, 5.4 (5.4–5.5); upper molar series, 4 (3.9–4.1).

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[1] Collection Amer. Mus. Nat. Hist.

Remarks.—This small form is known only from the State of Colima, but probably ranges to the southward along the coast of Michoacan. An adult example from Hacienda Magdalena is dark in color and in this respect approaches *O. m. melanotis,* but agrees otherwise with the small series of topotypes from near the Pacific coast.

Specimens examined.—Total number, 4, as follows:

Colima: Armeria, 3 (type and topotypes); Hacienda Magdalena, 1.

ORYZOMYS ROSTRATUS MERRIAM.

[Synonymy under subspecies.]

Geographic distribution.—Coastal plains and basal mountain slopes from extreme southeastern Tamaulipas through northern Puebla, Vera Cruz, northeastern Oaxaca, Tabasco, Campeche, and Yucatan to northern Quintana Roo; altitudinal range from sea level to about 1,500 feet; Arid and Humid Lower Tropical Zones.

General characters.—A rather large, rufescent species, not very unlike *O. melanotis* in external appearance, but cranial characters distinctive. (For additional characters, excepting specific color, see under *O. melanotis* group.)

Color.—Upperparts varying from ochraceous-buff to rich intense ochraceous-tawny, purest and brightest along cheeks and sides; the face, top of head, and back moderately lined with black hairs, which alter the general tone; underparts white or pale buffy white, the plumbeous basal color usually showing through; outer sides of ears blackish, the inner sides thinly and inconspicuously clothed with pale buffy or rusty reddish hairs; feet (epidermis) dull yellowish, thinly covered with short white hairs; tail (epidermis) varying from nearly uniform brownish throughout to irregularly yellowish on under side. *Young* (in first pelage): Upperparts darker and less rufescent than in adults.

Skull.—Similar in general to that of *O. melanotis,* but upper outline more elevated over anterior part of frontals; braincase relatively lower, the parietal region less expanded; rostrum heavier, more decurved; frontals narrower posteriorly; parietals less squarely truncate anteriorly, the fronto-parietal sutures less widely divergent; temporal ridges tending to spread less widely posteriorly; interparietal smaller, with a more evident posterior angle; outer wall of antorbital foramen broader, more extended anteriorly; anterior palatine foramina short and wide as in *melanotis;* dentition about the same.

Remarks.—Three geographic races of *O. rostratus* are recognizable, all of which closely intergrade and differ rather slightly in average size, color, or cranial details. Viewed as a whole, the forms exhibit a progressive decrease in size from west to east, typical *rostratus* being the largest and *O. r. yucatanensis* the smallest of the series.

ORYZOMYS ROSTRATUS ROSTRATUS Merriam.

Metlaltoyuca Rice Rat.

(Pl. II, figs. 4, 4a.)

Oryzomys rostratus Merriam, Proc. Washington Acad. Sci., III, p. 293, July 26, 1901.

Type locality.—Metlaltoyuca, Puebla, Mexico (altitude 800 feet).

Type.—No. 93112, ♂ old, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 5, 1898.

Geographic distribution.—Forested coastal plains and basal mountain slopes in southeastern Tamaulipas, northern Puebla, Vera Cruz, and northeastern Oaxaca; altitudinal range from sea level to about 1,500 feet; Arid and Humid Lower Tropical Zones.

General characters.—Similar to *O. r. megadon* and *O. r. yucatanensis*, but averaging larger than either; color rather pale, much as in *yucatanensis*, slightly paler, less rufescent than usual in *megadon;* skull broad.

Color.—*Fresh pelage:* Upperparts rich ochraceous-tawny, purest and brightest along cheeks and sides; the face, top of head, and back moderately lined with black hairs which darken the general tone; underparts nearly pure white in some specimens, pale buffy white in others, the dark basal color, however, usually showing through; outer sides of ears blackish, the inner sides thinly clothed with pale buffy or rusty reddish hairs; feet (epidermis) dull yellowish, thinly covered with short white hairs; tail varying from nearly uniform brownish throughout to irregularly yellowish on under side.

Skull.—Closely resembling those of *O. r. megadon* and *O. r. yucatanensis* in general form, but larger and relatively broader than either, the greater breadth most conspicuous in the braincase; dentition about as in *megadon*, decidedly heavier than in *yucatanensis*. Similar to that of *O. talamancæ*, but narrower; zygomata less squarely spreading, the sides more divergent anteriorly; frontal region narrower, the supraorbital ridges weakly developed; parietals with lateral wings less developed below temporal ridges; interparietal smaller. Contrasted with that of *O. melanotis*, the skull is larger, the upper outline more arched over anterior part of frontals; braincase relatively lower and flatter; frontals relatively narrower posteriorly; interparietal smaller.

Measurements.—Type: Total length, 277; tail vertebræ, 141; hind foot, 32.5. Average of seven adult topotypes: 255 (240–270); 136 (125–145); 31.9 (30–33). *Skull* (average of 7 adults—type and 6 topotypes): Greatest length, 31.4 (30.8–33.3); zygomatic breadth, 16.1 (15.4–17.4); interorbital breadth, 5 (4.6–5.2); width of braincase, 11.5 (11.4–11.7); nasals, 12.8 (11.5–13.8); anterior palatine foramina, 5.2 (4.4–6); palatal bridge, 6.6 (6.3–7.3); upper molar series, 4.3 (4.1–4.4).

Remarks.—While *O. r. rostratus* is distinguished by somewhat larger general size, and the greater breadth of the braincase is an especially noticeable cranial feature, the wide range of individual variation shown in large series of specimens renders the smaller examples difficult to separate from some of those of *O. r. megadon.* Specimens from Pasa Nueva and Achotal, Vera Cruz, are rather small and grade toward *megadon.* Those from Alta Mira, Tamaulipas, marking the extreme northern limit of the known range of *rostratus,* average slightly paler than typical examples.

Specimens examined.—Total number, 48, as follows:

Oaxaca: Santo Domingo (mountains near), 5.
Puebla: Metlaltoyuca 14 (type and topotypes).
Tamaulipas: Alta Mira, 5.
Vera Cruz: Achotal, 8;[1] Motzorongo, 1; Pasa Nueva, 6;[2] San Carlos, 9.[1]

ORYZOMYS ROSTRATUS MEGADON Merriam.

Tabasco Rice Rat.

(Pl. II, figs. 5, 5a.)

Oryzomys rostratus megadon Merriam, Proc. Washington Acad. Sci., III, p. 294, July 26, 1901.

Type locality.—Teapa, Tabasco, Mexico.

Type.—No. 99978, ♂ old, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, March 24, 1900.

Geographic distribution.—Heavily forested coastal plains and lower mountain slopes in Tabasco and Campeche; altitudinal range from sea level to at least 500 feet; Humid Lower Tropical Zone.

General characters.—Closely resembling *O. r. rostratus* and *O. r. yucatanensis,* but color slightly richer, more tawny than either; skull smaller than that of *rostratus* and larger than that of *yucatanensis.*

Color.—About like that of *O. r. rostratus,* but slightly darker and richer, more intense ochraceous-tawny.

Skull.—Similar to that of *O. r. rostratus,* but smaller and narrower; differing from that of *O. r. yucatanensis* mainly in larger size and heavier dentition.

Measurements.—Type: Total length, 272; tail vertebræ, 140; hind foot 32.5. Average of 2 adult topotypes: 236.5 (236–237); 121 (120–122); 30 (29–31). *Skull* (average of 3 adults—type and 2 topotypes): Greatest length, 30.5 (29.1–32.3); zygomatic breadth, 15.6 (15–16.5); interorbital breadth, 4.6 (4.4–4.9); width of braincase, 10.6 (10.5–10.7); nasals, 11.5 (11.3–12); anterior palatine foramina, 4.9 (4.6–5.1); palatal bridge, 6.3 (6–6.8); upper molar series, 4.3 (4.1–4.6).

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[1] Collection Field Mus. Nat. Hist.

[2] Collection Amer. Mus. Nat. Hist.

Remarks.—*O. r. megadon* appears to be a rather localized form. A series of specimens from Apazote, Campeche, agree most closely, as a whole, with typical *megadon*, but some are rather pale in color, and in the reduced size of molar teeth also approach *O. r. yucatanensis.*

Specimens examined.—Total number, 18, as follows:

Campeche: Apazote, 11; Champoton, 1.
Tabasco: Teapa 6 (type and topotypes).

ORYZOMYS ROSTRATUS YUCATANENSIS Merriam.

Yucatan Rice Rat.

(Pl. II, figs. 6, 6a.)

Oryzomys yucatanensis Merriam, Proc. Washington Acad. Sci., III, p. 294, July 26, 1901.

Type locality.—Chichen Itza, Yucatan, Mexico.

Type.—No. 108139, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 9, 1901.

Geographic distribution.—Forested lowlands of Yucatan and northern Quintana Roo; mainly Arid Lower Tropical Zone.

General characters.—Similar to *O. r. rostratus* and *O. r. megadon* but somewhat smaller than either; skull small, with very small molar teeth.

Color.—Much as in *O. r. rostratus* but decidedly paler, the general tone ochraceous-buff instead of rich ochraceous-tawny.

Skull.—Most closely resembling that of *O. r. megadon*, but smaller, with short anterior palatine foramina and decidedly smaller molar teeth.

Measurements.—Type: Total length, 235; tail vertebræ, 119; hind foot, 32. Adult from Puerto Morelos, Quintana Roo, 255; 136; 31. *Skull* (type): Greatest length, 28.7; zygomatic breadth, 15; interorbital breadth, 4.6; width of braincase, 10.8; nasals, 11.8; anterior palatine foramina, 4.2; palatal bridge, 5.9; upper molar series, 3.7.

Remarks.—This rather small pale form of *O. rostratus* apparently passes into *O. r. megadon* in southern Campeche. The specimens from Apazote are referred to *megadon*, with which the majority agree most closely, but several are indistinguishable in color from *O. r. yucatanensis*, and, as they present no wide departure in cranial details, might be assigned to that form but for the presence of the larger or darker examples in the same series.

Specimens examined.—Total number, 5, as follows:

Quintana Roo: Puerto Morelos, 1.
Yucatan: Chichen Itza, 4 (type and topotypes).

Oryzomys alfaroi Group.

Geographic distribution.—Mountainous districts from northern Puebla, Mexico, south through Central America and northwestern South America to Ecuador; altitudinal range, from about 1,000 to 10,000 feet, mainly in Humid Upper and Lower Tropical Zones (fig. 5).

General characters.—Size small; form slender; tail usually longer than head and body, thinly and rather indistinctly haired; ears large and conspicuous, thinly clothed externally and internally with short, fine, blackish hairs; general pelage usually rather short and harsh, becoming longest in forms ranging at high elevations; vibrissæ about as long as head; toes of hind feet inconspicuously webbed at base, the longest three bearing tufts of silvery whitish bristles which project beyond the ends of the claws as in the *O. talamancæ* group; claws short and recurved, compressed and sharp pointed. General color dark, the upperparts usually near ochraceous-tawny, heavily mixed with black; underparts dull whitish or pale buffy.

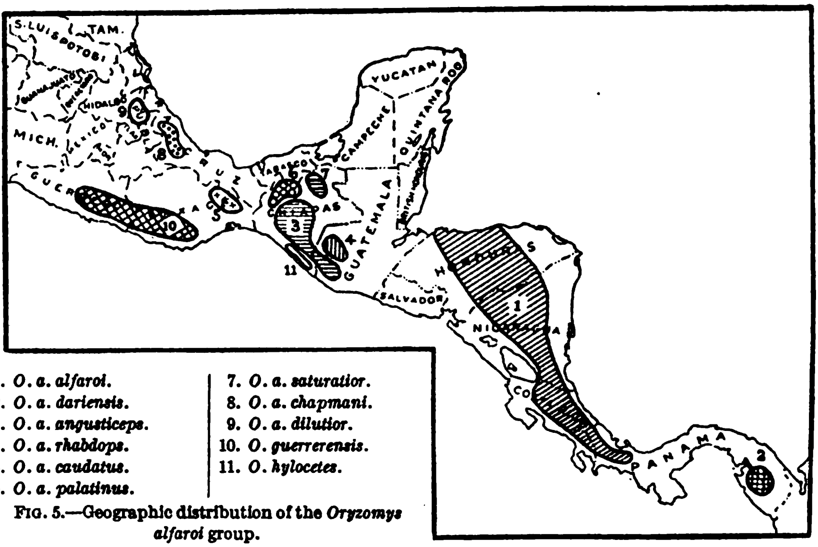

FIG. 5.—Geographic distribution of the *Oryzomys alfaroi* group.

Skull.—Small and delicate in structure, with rostrum elongated, the braincase moderately broad and rather low; maxillary arm of zygoma weakly developed; outer wall of antorbital foramen with anterior border rounded, the antorbital notch only moderately deep as viewed from above; nasals and premaxillæ ending posteriorly in about the same plane; frontal region broad, the lateral margins very slightly elevated to form delicate supraorbital ridges; temporal ridges slightly developed anteriorly along parieto-squamosal sutures, usually becoming obsolescent posteriorly in crossing lateral wings of parietals; interparietal large, somewhat irregularly pointed-elliptical in form; anterior palatine foramina short and broad, shorter than palatal bridge and not usually reaching anterior plane of first molars; palatal pits rather large and rounded; sphenopalatine vacuities present but small; interpterygoid fossa broad; audital bullæ small; angle of mandible short and broad, the inferior border even more strongly turned inward than in the *O. talamancæ* group; coronoid process with free portion short owing to high connecting ridge reaching nearly to summit of condyle; molars small, the reentrant angles shallow and the crown arrangement, especially the enamel islands in the second upper molars, much as in the *O. palustris* group, but inner reentrant angles in first upper molars broader. More reliable distinguishing characters are presented by the skull and teeth; the molars are less deeply cleft by reentrant angles in the *O. alfaroi* group, and the enamel island present at the postero-internal base of the paracone of the second upper molar (moderately worn) is absent in the *talamancæ* group.

Remarks.—This group, comprised of a series of small, dark-colored, closely allied, and somewhat localized forms typified by *O. alfaroi*, extends in an irregular chain along the backbone of the continent from southern Mexico to northwestern South America, one form at least ranging as far south as Ecuador. While the *O. palustris* and *O. talamancæ* groups range mainly at low elevations, or are restricted to the vicinity of water at the higher levels, *alfaroi* and its allies often inhabit well-drained but moist mountain slopes, where they commonly ascend to high elevations.

O. alfaroi and its relatives approach the members of the *O. talamancæ* group in general external characters, and the two partially overlap in geographic range. In appearance individuals may be much alike, both groups having large ears, appearing nearly naked, and slender limbs; forms of the *alfaroi* group are, however, usually smaller and decidedly darker in general color; the ears are smaller, but not markedly different in color.

Key to Species and Subspecies of the O. alfaroi Group.

a^1. Zygomata broader posteriorly than anteriorly.
  b^1. Upperparts darker ochraceous-buff or ochraceous-tawny.
    c^1. Upperparts less intense ochraceous-buff or ochraceous-tawny.
      d^1. Median dorsal area not distinctly blackish.
        e^1. Size smaller; total length less than 240.
          f^1. Skull broader; zygomatic breadth 13 or more.
            g^1. Anterior palatine foramina usually 4 or more.
              h^1. Rostrum more massive. (Northern Puebla.) **O. a. dilutior** (p. 68).
              h^2. Rostrum less massive. (Central Vera Cruz.) **O. a. chapmani** (p. 67).

*g*². Anterior palatine foramina usually less than 4. (Mountains of Honduras; Nicaragua; Costa Rica; western Panama.)
O. a. alfaroi (p. 59).
*f*². Skull narrower; zygomatic breadth less than 13. (Mountains of southern Tabasco and northwestern Chiapas.)... **O. a. palatinus** (p. 65).
*e*². Size larger; total length 240 or more.
*f*¹. Pelage short; tail about 140. (Mountains of northeastern Oaxaca.)
O. a. caudatus (p. 64).
*f*². Pelage long; tail less than 135. (High mountains of southwestern Guatemala and of central and southern Chiapas.)
O. a. angusticeps (p. 62).
*d*². Median dorsal area distinctly blackish. (Mountains of northern Chiapas.)
O. a. saturatior (p. 66).
*c*². Upperparts more intense ochraceous-tawny. (Eastern Panama.)
O. a. dariensis (p. 61).
*b*². Upperparts paler ochraceous-buff or ochraceous-tawny. (Pacific slope of Sierra Madre in Guerrero and Oaxaca.).................. **O. guerrerensis** (p. 69).
*a*². Zygomata broader anteriorly than posteriorly.
*b*¹. Size larger; total length 225 or more. (Southeastern Guatemala.)
O. a. rhabdops (p. 63).
*b*². Size smaller; total length less than 225. (Southern Chiapas.)
O. hylocetes (p. 70).

ORYZOMYS ALFAROI ALLEN.

[Synonymy under subspecies.]

Geographic distribution.—Heavily forested mountain slopes from northern Puebla south through southern Mexico and Central America, at least to Colombia and Ecuador; altitudinal range from about 1,000 to 10,000 feet, mainly in Humid Upper and Lower Tropical Zones.

General characters.—Size small; color dark; skull light and rather delicate in structure. Similar in general to *O. guerrerensis*, but color much darker, and skull differing in detail. (For additional general characters see under *O. alfaroi* group.)

Color.—*Fresh pelage:* Upperparts varying from dark ochraceous-buff to ochraceous-tawny, tawny, russet, or cinnamon-brown, usually heavily mixed with black, this color often predominant over dorsum, the lighter element purest and becoming more or less ochraceous-buffy on cheeks, shoulders, and sides; underparts dull white or buffy, thinly overlying the dark plumbeous basal color; nose blackish; inner and outer sides of ears thinly clothed with very short black hairs, light ochraceous-buffy subauricular spots present in some forms, absent in others; feet dull whitish, the elongated silvery tufts on toes of hind feet projecting beyond points of longer claws; feet (epidermis) yellowish, thinly clothed above with very short glossy white hairs; tail nearly naked, brownish or blackish above, yellowish below basally, becoming dark all around toward tip. *Young* (in first pelage): Upperparts blackish, finely and inconspicuously mixed with ochraceous-tawny; underparts darker than in adults, the dark basal color thinly overlaid with white; feet varying from dull whitish to brownish; tail blackish.

Skull.—Similar in general to that of *O. guerrerensis*, but more elongated; braincase higher, less flattened. In the anteriorly spreading zygomata, one form of *O. alfaroi* (*O. a. rhabdops*) approaches *O. hylocetes*, but the latter is much smaller, with very small teeth, and present material seems to indicate specific distinctness. (For additional characters see under *O. alfaroi* group.)

Remarks.—All the North American members of the *O. alfaroi* group, excepting *O. hylocetes* and *O. guerrerensis*, and the South American forms *O. palmiræ* and *O. gracilis*, appear to be assignable subspecifically to *O. alfaroi*.[1] While complete intergradation may not be shown by the material examined, the more essential characters prevail with such uniformity throughout the series as to leave little room for doubt of its existence. The accession of new material may not improbably show that *hylocetes* and *guerrerensis* are also geographic races of *alfaroi*. Typical *alfaroi* presents closer resemblance to the geographically distant race *O. a. chapmani*, of Vera Cruz, than to the annectent forms inhabiting the high mountains of Chiapas and Guatemala. This resemblance between the more widely removed subspecies may be due to the fact that the intermediate races occupy more diversified areas, most of them having ascended to high elevations where peculiar environmental conditions would conduce to differentiation.

ORYZOMYS ALFAROI ALFAROI (ALLEN).

ALFARO RICE RAT.

(Pl. III, figs. 1, 1a.)

Hesperomys (*Oryzomys*) *alfaroi* Allen, Bull. Amer. Mus. Nat. Hist., III, p. 214, April 17, 1891.

Oryzomys alfaroi Allen, Abstr. Proc. Linn. Soc. New York, 1893–94, p. 36, July 20, 1894.

Oryzomys alfaroi incertus Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 655, October 13, 1908. Type from Rio Grande, Nicaragua, No. 28584, ♂ ad., Amer. Mus. Nat. Hist.; collected by W. B. Richardson, March 28, 1908.

Type locality.—San Carlos, Costa Rica.

Type.—No. $\frac{3659}{2808}$, ♀ subadult, American Museum of Natural History; collected by Anastasio Alfaro, December, 1888.

Geographic distribution.—Heavily forested mountainous portions of Honduras, Nicaragua, Costa Rica, and western Panama; altitudinal range from about 1,000 to 4,000 feet; mainly in Humid Lower Tropical Zone.

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[1] The South American forms will therefore stand as follows:

Oryzomys alfaroi palmiræ Allen................	Miraflores, Colombia.
Oryzomys alfaroi gracilis Thomas..............	Concordia, Medellin, Colombia.

General characters.—A rather small form with short pelage, resembling *O. a. dariensis*, but coloration duller, less rufescent; skull differing in slight details. Very similar in general to *O. c. chapmani*, but color usually duller; skull with shorter anterior palatine foramina. Smaller than *O. a. angusticeps* and *O. a. rhabdops*, with shorter pelage than either.

Color.—Upperparts varying from ochraceous-buff to dull ochraceous-tawny, heavily mixed with black. (Other colors as given under *O. alfaroi*.)

Skull.—Size medium for the group, rather narrow and elongated with narrowly spreading zygomata and short, wide anterior palatine foramina. In general form very similar to that of *O. a. dariensis*, but braincase and frontal region usually broader; apparently differing from those of *O. a. angusticeps* and *O. a. chapmani* most noticeably in shorter anterior palatine foramina. Compared with that of *O. a. rhabdops* the skull is decidedly narrower, with smaller, less inflated braincase, and zygomata much less divergent anteriorly.

Measurements.—Average of 6 adults from Tuis, Costa Rica: Total length, 210 (188–221); tail vertebræ, 109 (102–114); hind foot, 26.3 (26–27). *Skull* (average of same): Greatest length, 26.7 (25.6–28.3); zygomatic breadth, 13.5 (13.2–14.1); interorbital breadth, 5.2 (5.1–5.5); width of braincase, 10.5 (10.1–10.8); nasals, 10.9 (10.3–11.5); anterior palatine foramina, 3.9 (3.5–4.9); palatal bridge, 5.4 (5.3–5.7); upper molar series, 3.7 (3.6–3.8).

Remarks.—While a considerable gap separates the known geographic ranges of *O. a. alfaroi* and *O. a. dariensis*, these forms exhibit such close approach in size, color, and cranial details that intergradation may be safely assumed. Specimens from Yaruca, Honduras, are referable to *alfaroi*, but in the larger size shown by some examples are not very unlike *O. a. angusticeps* and *O. a. rhabdops*. Three specimens from Managua, Nicaragua, recorded by Thomas[1] as *O. gracilis*, were probably assignable to *alfaroi*.

Allen's "*O. a. incertus*" was based on rather richly colored specimens which are well within the range of individual variation exhibited by typical *alfaroi*, as the accession of additional material indicated to him.[2]

The general range of *alfaroi* overlaps that of *O. talamancæ*, and as it may closely resemble that species in general appearance some confusion of the two has resulted. While many examples may be inseparable in color, *alfaroi* is a smaller animal than *talamancæ*. The skull of *alfaroi* is distinguished by its smaller size and more delicate structure, the maxillary arm of the zygoma is more slender and the teeth are decidedly smaller; the second upper molar has a large, elongated enamel island at the postero-internal base of the paracone, and the internal reentrant angle extends less than halfway across the crown of the moderately worn tooth, while in *talamancæ* the enamel island mentioned is absent or represented only by a small island near the apex of the reentrant angle, which in this species reaches halfway across the molar crown.

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[1] Thomas, Oldfield, Ann. Mag. Nat. Hist., ser. 6, XVI, p. 57, July, 1895.

[2] Allen, J. A., Bull. Amer. Mus. Nat. Hist., XXVIII, p. 99, Apr. 30, 1910.

Specimens examined.—Total number, 86, as follows:

Costa Rica: San Carlos, 3 (type and topotypes);[1] Tuis, 15;[1] exact locality unknown, 7.[1]

Honduras: Yaruca, 19.[2]

Nicaragua: Chontales, 6;[1] Jalapa, 2;[1] Jicaro, 1;[1] Jinotega, 1;[3] Rio Coco, 5;[1] Rio Grande, 3 (including type of "*incertus*");[1] San Juan, 5;[1] Tuma, 2;[1] Uluce, 2;[1] exact locality unknown, 1.[1]

Panama: Boquete, 14.[4]

ORYZOMYS ALFAROI DARIENSIS GOLDMAN.

DARIEN RICE RAT.

(Pl. III, figs. 2, 2a; Pl. V, figs. 6; Pl. VI, figs. 3, 3a.)

Oryzomys alfaroi dariensis Goldman, Proc. Biol. Soc. Washington, XXVIII, p. 128, June 29, 1915.

Type locality.—Cana, eastern Panama (altitude 2,000 feet).

Type.—No. 178660, ♀ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, March 4, 1912.

Geographic distribution.—Heavily forested mountain slopes in eastern Panama at 2,000 feet altitude, and probably adjacent portions of Colombia; Humid Lower Tropical Zone.

General characters.—A small form closely allied to *O. a. alfaroi;* color of upperparts richer, more rufescent; skull usually narrower. Similar to the South American forms *O. a. gracilis* and to *O. a. palmiræ,* but color more rufescent and skull differing in detail.

Color.—*Fresh pelage:* Upperparts between ochraceous-tawny and tawny, finely mixed with black; becoming paler and ochraceous-buffy on cheeks, shoulders, and lower part of sides; underparts, feet, and tail as given under *O. alfaroi.*

Skull.—About like that of *O. a. alfaroi,* but braincase and frontal region usually narrower. Closely resembling that of *O. a. palmiræ,* of South America, but shorter, with more widely spreading zygomata and smaller teeth. Compared with Ecuadorean specimens assumed to represent *O. a. gracilis,* the skull is more massive, with more widely spreading zygomata.

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[1] Collection Amer. Mus. Nat. Hist.

[2] Fourteen specimens in Mus. Comp. Zool.; 2 in Field Mus. Nat. Hist.

[3] Collection Field Mus. Nat. Hist.

[4] Eleven specimens in Mus. Comp. Zool.; 2 in Field Mus. Nat. Hist.; 1 in Amer. Mus. Nat. Hist.

Measurements.—Type: Total length, 203; tail vertebræ, 107; hind foot, 25.5. Average of 5 adult topotypes: 220 (212–226); 113 (107–117); 24.6 (23–26). *Skull* (average of 6 adults, type and 5 topotypes): Greatest length, 27.3 (26.5–27.8); zygomatic breadth, 14.3 (14–14.7); interorbital breadth, 4.8 (4.6–5); width of braincase, 10.3 (10–10.5); nasals, 11.1 (10.6–11.4); anterior palatine foramina, 4.3 (4–4.8); palatal bridge, 5.6 (5–5.9); upper molar series, 3.7 (3.6–3.9).

Remarks.—This small, slender rice rat differs from typical *O. a. alfaroi*, of Costa Rica, mainly in richer, more tawny coloration. It is closely allied to the Colombian form described as *O. palmiræ* and the latter is clearly assignable to subspecific rank, if it does not prove to be identical with *O. a. gracilis*, the type of which came from farther north in the Cauca Valley. Comparison with specimens from northern Ecuador, assigned to *gracilis* by Mr. Oldfield Thomas, and reference to the original description of that species indicate that the two are very nearly related. The description of the color of *gracilis*, however, seems to apply to the Ecuadorean specimens, or to *palmiræ*, rather than to the Darien animal. Moreover, the skull *O. a. dariensis* is distinguished from that of *gracilis*, as here understood, by the greater lateral expansion of the zygomata.

O. talamancæ also occurs at the type locality of *dariensis* and the two are superficially much alike. The smaller size, especially the smaller hind foot, usually distinguishes *dariensis* externally, while the skull is smaller, more delicate in structure, the maxillary arm of the zygoma more slender and the molar teeth much smaller; the second upper molar has a large elongated enamel island at the postero-internal base of the paracone, and the internal reentrant angle extends less than half way across the crown of the moderately worn tooth, much as in *O. palustris*. In *talamancæ* the enamel island is absent and the reentrant angle reaches halfway across the molar crown.

Specimens examined.—Eleven, from type locality.

ORYZOMYS ALFAROI ANGUSTICEPS MERRIAM.

VOLCAN SANTA MARIA RICE RAT.

Oryzomys angusticeps Merriam, Proc. Washington Acad. Sci., III, p. 292, July 26, 1901.

Type locality.—Volcan Santa Maria, Guatemala (altitude, 9,000 feet).

Type.—No. 76816, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 22, 1896.

Geographic distribution.—Heavily forested slopes of high mountains in southwestern Guatemala and central and southern Chiapas; altitudinal range from about 8,000 to 9,500 feet.

General characters.—Similar to *O. a. alfaroi* but larger, with longer pelage; anterior palatine foramina longer. Closely approaching *O. a. rhabdops* in size, but color darker and skull differing in detail.

Color.—Lighter element in upperparts pale cinnamon brownish, heavily mixed with black, the general tone appreciably darkened by the dark plumbeous basal color of the long pelage; underparts and sides of muzzle light ochraceous-buffy; ears, feet, and tail as given under *O. alfaroi.*

Skull.—Similar to that of *O. a. alfaroi*, but larger, zygomata more squarely spreading anteriorly, the sides more nearly parallel; frontal region usually narrower; anterior palatine foramina longer. Approaching that of *O. a. rhabdops* in size, but zygomata less divergent anteriorly.

Measurements.—Type: Total length, 245; tail vertebræ, 134; hind foot, 29. *Skull* (type): Greatest length, 28.6; zygomatic breadth, 14; interorbital breadth, 4.6; width of braincase, 10.3; nasals, 10.6; anterior palatine foramina, 5; palatal bridge, 5.4; upper molar series, 3.6.

Remarks.—Aside from its geographic neighbor, *O. a. rhabdops*, no other North American form of the *O. alfaroi* group attains so high an altitude; like *rhabdops* it has developed a longer pelage than forms ranging at lower elevations. The skull of the type of *O. a. angusticeps* seems to be abnormally narrow; the topotypes are all young and their skulls of little value for comparative purposes. An apparent tendency toward greater breadth shown in the skulls of specimens from San Cristobal and Pinabete, Chiapas, is believed to be within the probable range of individual variation; on the other hand, they do not differ appreciably from some skulls of *rhabdops*, and suggest intergradation. In size and color the Chiapas examples are very similar to the topotypes.

Specimens examined.—Total number, 16, as follows:

Chiapas: Pinabete, 2; San Cristobal, 10.
Guatemala: Volcan Santa Maria 4 (type and topotypes).

ORYZOMYS ALFAROI RHABDOPS MERRIAM.

CALEL RICE RAT.

(Pl. III, figs. 3, 3a.)

Oryzomys rhabdops Merriam, Proc. Washington Acad. Sci., III, p. 291, July 26, 1901.

Type locality.—Calel, Guatemala (altitude, 10,000 feet).

Type.—No. 76813, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 15, 1896.

Geographic distribution.—Known only from type locality, at about 10,000 feet altitude on the upper slope of the high mountains in southwestern Guatemala.

General characters.—Size large; pelage very long for a member of the *O. alfaroi* group, the longer hairs on dorsum reaching about 11 mm.;

color rather pale, upperparts near ochraceous-tawny; skull broad with anteriorly divergent zygomata. Similar in general to *O. a. angusticeps*, but color paler, and skull differing in detail.

Color.—Fresh pelage: Upperparts near ochraceous-tawny, richest and purest on cheeks, shoulders, and sides, the back darkened by black hairs, but less copiously than in most forms of *O. alfaroi;* sides of muzzle and underparts in general light ochraceous-buffy; nose deep black, except extreme tip which, like lips, is whitish; ears black, with more or less distinct light ochraceous-buffy subauricular spots; feet and tail as given under *O. alfaroi.* *Young* (in first pelage): Upperparts blackish, inconspicuously tinged with ochraceous-tawny; underparts plumbeous, lightly overlaid with light ochraceous-buff.

Skull.—Skull broad, with large inflated braincase and anteriorly diverging zygomata. Similar to that of *O. a. angusticeps*, but zygomata wider anteriorly than posteriorly (sides more nearly parallel in *angusticeps*). In general form, especially the anteriorly spreading zygomata, similar to that of *O. hylocetes*, but much larger, with shorter anterior palatine foramina.

Measurements.—Type: Total length, 255; tail vertebræ, 141; hind foot, 29.5. Adult topotype: 255; 138; 28.5. *Skull* (average of two adults—type and topotype): Greatest length, 28.6 (28.4–28.8); zygomatic breadth, 14.8 (14.6–15.1); interorbital breadth, 4.8 (4.8–4.9); width of braincase, 10.9 (10.8–11.1); nasals, 11 (10.5–11.5); anterior palatine foramina, 4.3 (4.2–4.5); palatal bridge, 5.7 (5.5–5.9); upper molar series, 3.8 (3.7–3.9).

Remarks.—No other North American form of the genus is known to range 10,000 feet above sea level, but a near geographic neighbor, *O. a. angusticeps*, which has also pushed up above the Tropical Zones on mountains of similar elevation, approaches and may equal this altitude. The two forms are evidently closely allied. Distinguishing cranial characters are developed mainly in adults, the skulls of most of the younger examples being apparently inseparable. In the remarkable anterior expansion of the zygomata the skull of *O. a. rhabdops* resembles that of *O. hylocetes*, but the latter appears to be a very distinct form.

Specimens examined.—Fourteen, from type locality.

ORYZOMYS ALFAROI CAUDATUS MERRIAM.

COMALTEPEC RICE RAT.

(Pl. III, figs. 4, 4a.)

Oryzomys chapmani caudatus Merriam, Proc. Washington Acad. Sci , III, p. 289, July 26, 1901.

Type locality.—Comaltepec, Oaxaca, Mexico (altitude 3,500 feet).

Type.—No. 68641, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, July 31, 1894.

Geographic distribution.—Mountains of northeastern Oaxaca; altitudinal range from 3,500 to 6,500 feet; Humid Upper Tropical Zone.

General characters.—Size largest of the *O. alfaroi* group; color dark; pelage short. Similar in general to *O. a. chapmani*, but decidedly larger, with the lighter colored admixture in upperparts of ochraceous-buffy instead of ochraceous-tawny; skull larger and more massive than usual in the *alfaroi* group.

Color.—*Fresh pelage:* Upperparts ochraceous-buffy, heavily mixed with black, the latter color predominating, especially along lower part of back; underparts and sides of muzzle light ochraceous-buffy; lips and chin whitish; nose black; ears, feet, and tail as given under *O. alfaroi*.

Skull.—Size very large and structure heavy for *O. alfaroi*. Very similar in general form to that of *O. a. chapmani*, but much larger with more swollen rostrum.

Measurements.—Type: Total length, 257; tail vertebræ, 141; hind foot, 30. *Skull* (type): Greatest length, 29; zygomatic breadth, 15; interorbital breadth, 5; width of braincase, 11.3; nasals, 11.4; anterior palatine foramina, 4.8; palatal bridge, 5.2; upper molar series, 3.9.

Remarks.—*O. a. caudatus* was based on a single specimen which seems to indicate a subspecies still larger than *O. a. rhabdops* and *O. a. angusticeps*, but the extent of individual variation remains to be determined. Although not very widely differing from *angusticeps* it seems to be most closely allied to *O. a. chapmani*, the greater size being the chief distinguishing character. An immature example from 6,500 feet altitude at Totontepec, Oaxaca, is referable to the same form.

Specimens examined.—Total number, 2, as follows:

Oaxaca: Comaltepec, 1 (type); Totontepec, 1.

ORYZOMYS ALFAROI PALATINUS MERRIAM.

TEAPA RICE RAT.

(Pl. III, figs. 5, 5a.)

Oryzomys palatinus Merriam, Proc. Washington Acad. Sci., III, p. 290, July 26, 1901.

Type locality.—Teapa, Tabasco, Mexico (altitude, 3,000 feet).

Type.—No. 99977, ♀ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, April 1, 1900.

Geographic distribution.—Forested mountain slopes in southern Tabasco and northwestern Chiapas; known altitudinal range from about 3,000 to 3,500 feet; Humid Upper Tropical Zone.

General characters.—A small form, similar to *O. a. chapmani* in color, but skull narrower, lighter, and more like that of the darker subspecies *O. a. saturatior*.

Color.—Type in fresh pelage: Upperparts rich ochraceous-tawny, finely and uniformly lined with black from nose over top of head and back to near base of tail, the tawny element becoming purer and paler on cheeks and along lower part of sides; underparts and feet dull whitish; tail dark brownish, except basal half of under side, which is dull yellowish. Specimens from Ocuilapa, Chiapas, apparently referable to this form, are indistinguishable in color from *O. a. chapmani.*

Skull.—Size small, general form long and narrow, structure light. Scarcely distinguishable from some of the narrower skulls of *O. a. saturatior;* zygomata very slender as in that form. Similar in general to that of *O. a. chapmani,* but narrower, maxillary arm of zygoma more slender.

Measurements.—Type: Total length, 209; tail vertebræ, 106; hind foot, 25. Adult from Tumbala, Chiapas: 222; 116; 27. *Skull* (type): Greatest length, 26.7; zygomatic breadth, 12.6; interorbital breadth, 4.8; width of braincase, 10.2; nasals, 10.2; anterior palatine foramina, 3.8; palatal bridge, 5.5; upper molar series, 3.8.

Remarks.—In *O. a. palatinus* the general color of *O. a. chapmani* seems to be combined with the narrower, lighter skull of the darker-colored form *O. a. saturatior.* The scanty material available indicates that intergradation of *palatinus* with *saturatior* is probable, since the differential characters are slight and both forms inhabit the northern slope of the same mountain range.

Specimens examined.—Total number, 5, as follows:

Chiapas: Ocuilapa, 3; Tumbala, 1.
Tabasco: Teapa, 1 (type).

ORYZOMYS ALFAROI SATURATIOR MERRIAM.

DUSKY RICE RAT.

Oryzomys chapmani saturatior Merriam, Proc. Washington Acad. Sci., III, p. 290, July 26, 1901.

Type locality.—Tumbala, Chiapas, Mexico (altitude, 5,000 feet).

Type.—No. 76183, ♀ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, October 23, 1895.

Geographic distribution.—Forested northern slope of mountains of northern Chiapas, at 5,000 feet altitude, limits of range unknown; Humid Upper Tropical Zone.

General characters.—Size rather small—about as in *O. a. alfaroi* and *O. a. chapmani;* color very dark. Closely allied to *O. a. palatinus* and *chapmani,* but darker than either, the back blackish and underparts usually distinctly buffy.

Color.—Upperparts cinnamon brownish, very heavily mixed with black, the top of head and median dorsal area blackish; underparts, except chin and throat, varying from light to dark ochraceous-buff; chin and throat more or less distinctly whitish, the fur in some examples pure white to roots along a narrow median line; ears black; feet brownish to toes, the toes dull yellowish, those of hind feet bearing the silvery terminal bristles present throughout the group; tail usually dark all around, but in some examples yellowish on under side at base. *Young* (in first pelage): Upperparts nearly black, the cinnamon brownish hairs inconspicuous and restricted mainly to the sides; underparts dark plumbeous, very thinly overlaid with ochraceous-buff; feet and tail blackish.

Skull.—Size small and structure light. About like that of *O. a. palatinus*, but usually broader. Similar to that of *O. a. chapmani*, but averaging slightly smaller, with less swollen rostrum and more slender zygomata.

Measurements.—Type: Total length, 218; tail vertebræ, 120; hind foot, 25.5. Average of 10 adults (type and 9 topotypes): 208.4 (195–225); 111.1 (105–122); 26.1 (25–28). *Skull* (average of 3 adults—type and 2 topotypes): Greatest length, 25.3 (25.2–25.4); zygomatic breadth, 12.8 (12.4–13.5); interorbital breadth, 4.7 (4.5–4.8); width of braincase, 10.1 (10–10.3); nasals, 9.8 (9.5–10.2); anterior palatine foramina, 4.2 (3.7–4.5); palatal bridge, 5.1 (4.9–5.3); upper molar series, 3.6 (3.5–3.6).

Remarks.—The very dark colors of *O. a. saturatior* appear to be directly due to environmental conditions. The area inhabited by this form is heavily forested and excessively humid; torrential rains occur during the wet season and fog enshrouds the mountains nearly throughout the year. Two specimens from Tumbala, with narrow skulls and slender rostra, approach *O. a. palatinus*, whose range is doubtless contiguous, and point to intergradation with that form.

Specimens examined.—Seventeen, from type locality.

ORYZOMYS ALFAROI CHAPMANI Thomas.

Chapman Rice Rat.

Oryzomys chapmani Thomas, Ann. Mag. Nat. Hist., ser. 7, I, p. 179, February, 1898.

Type locality.—Jalapa, Vera Cruz, Mexico (altitude, 4,400 feet).

Type.—97.9.9.30, British Museum; collected by Frank M. Chapman, March 31, 1897.

Geographic distribution.—Forested eastern slopes of the Mexico plateau region in central Vera Cruz; known altitudinal range from 4,400 to 6,000 feet; Humid Upper Tropical Zone.

General characters.—Closely resembling *O. a. alfaroi;* size and color very similar, but general tone of upperparts averaging slightly richer, more tawny; cranial characters distinctive. Size about as in *O. a. dilutior*, but color slightly more tawny; skull much less massive;

differing from *O. a. caudatus* in much smaller size and more tawny color.

Color.—*Fresh pelage:* Upperparts near ochraceous-tawny (becoming russet in some old adults), finely and abundantly mixed with black, the tawny element purer but somewhat paler and grading toward dark ochraceous-buff along cheeks and lower part of sides; underparts whitish or pale buffy, the plumbeous basal color showing through except over a narrow median area on throat and chest, where the fur in some specimens is pure white to roots; ears black, light subauricular spots usually present; feet and tail as given under *O. alfaroi.* *Young* (in first pelage): Upperparts blackish, inconspicuously mixed with ochraceous-tawny; underparts darker than in adults, the dark basal color less heavily overlaid with white; feet and tail brownish (becoming paler in adults).

Skull.—Size and general form much as in *O. a. alfaroi,* but tending to be shorter and relatively broader, the zygomata more widely or squarely spreading anteriorly; frontal region usually narrower; anterior palatine foramina longer, commonly reaching anterior plane of first molars; dentition about the same. Similar to that of *O. a. dilutior,* but less massive; rostrum less swollen and decurved; maxillary arm of zygoma more slender. Much like that of *O. a. caudatus,* but much smaller.

Measurements.—Average of 10 adult topotypes: Total length, 224 (202–265); tail vertebræ, 117.9 (108–132); hind foot, 25.1 (24–27). *Skull* (average of 7 adult topotypes): Greatest length, 26.4 (25.4–27.3); zygomatic breadth, 13.7 (13.1–14.4); interorbital breadth, 4.7 (4.4–4.8); width of braincase, 10.7 (10.2–11); nasals, 10.3 (9.6–10.9); anterior palatine foramina, 4.4 (4–4.7); palatal bridge, 5.3 (5–5.6); upper molar series, 3.8 (3.7–3.9).

Remarks.—The general resemblance of *O. a. chapmani* to *O. a. alfaroi* is noteworthy, in view of their geographic separation and the occurrence of apparently annectent forms that differ considerably from both. The annectent forms, however, inhabit diversified areas, some having ascended to high elevations, where their differentiation has probably been the result of rather local environmental conditions.

Specimens examined.—Total number, 25, as follows:

Vera Cruz: Jalapa, 17 (type and topotypes);[1] Jico, 6; Mirador, 1; Teocelo, 1.[2]

ORYZOMYS ALFAROI DILUTIOR MERRIAM.

PUEBLA RICE RAT.

(Pl. III, figs. 6, 6a.)

Oryzomys chapmani dilutior Merriam, Proc. Washington Acad. Sci., III, p. 290, July 26, 1901.

Type locality.—Huauchinango, Puebla, Mexico (altitude 5,000 feet).

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[1] Thirteen in collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

Type.—No. 93124, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 10, 1898.

Geographic distribution.—Eastern slope of Mexican plateau region at 5,000 feet altitude in northern Puebla; limits of range unknown; Humid Upper Tropical Zone.

General characters.—Similar in size to *O. a. chapmani*, but color slightly paler, less tawny; skull more massive.

Color.—About as in *O. a. chapmani*, but slightly paler, the general tone less tawny.

Skull.—Most like that of *O. a. chapmani*, but more massive; rostrum more swollen, the upper outline more strongly decurved; maxillary arm of zygoma heavier.

Measurements.—Type: Total length, 223; tail vertebræ, 117; hind foot, 28. An adult topotype: 225; 125; 27.5. *Skull* (type and adult topotype): Greatest length, 27.6, 27.4; zygomatic breadth, 15, 14.2; interorbital breadth, 4.9, 4.6; width of braincase, 10.8, 10.4; nasals, 10.3, 10.5; anterior palatine foramina, 4.6, 4.4; palatal bridge, 5.2, 5; upper molar series, 4, 4.

Remarks.—The range of *O. a. dilutior* marks the northern limit of the *O. alfaroi* group. The subspecies appears to be a well-marked form, requiring close comparison only with *O. a. chapmani.*

Specimens examined.—Three, from type locality.

ORYZOMYS GUERRERENSIS GOLDMAN.

GUERRERO RICE RAT.

(Pl. III, figs. 7, 7a.)

Oryzomys guerrerensis Goldman, Proc. Biol. Soc. Washington, XXXVIII, p. 127, June 29, 1915.

Type locality.—Omilteme, Guerrero, Mexico (altitude 8,000 feet).

Type.—No. 127517, ♂ adult (molars moderately worn), United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, May 20, 1903.

Geographic distribution.—Forested Pacific slope of Sierra Madre in Guerrero and Oaxaca, Mexico; altitudinal range from 3,000 to about 8,000 feet; Humid Upper Tropical Zone.

General characters.—Size small; color averaging palest of the North American forms of the *O. alfaroi* group. Similar in general to *O. a. chapmani*, but color paler and skull smaller and flatter.

Color.—Upperparts varying from dark ochraceous-buff to dark ochraceous-tawny, purest on cheeks, shoulders, and sides; the face, top of head, and back darkened by a moderate admixture of black hairs; underparts dull grayish white, the dark basal color of the fur everywhere showing through, except in 2 examples out of 8, in which the fur is pure white to roots along a narrow median line on chin and throat; outer and inner sides of ears well clothed with deep glossy black hairs; feet whitish; tail brownish above, irregularly yellowish below to near tip, which is dusky all around. *Young* (in first pelage): As in *O. a. chapmani.*

Skull.—Small and short, the braincase broad and somewhat flattened. Similar to that of *O. a. chapmani*, but usually smaller and flatter; zygomata tending to curve evenly outward, the sides less nearly parallel; sides of rostrum more tapering anteriorly; ascending branches of premaxillæ usually broader posteriorly; maxillary arm of zygoma more slender; incisors smaller.

Measurements.—Type: Total length, 220; tail vertebræ, 118; hind foot, 27. Adult from Pluma, Oaxaca: 221; 116; 26.5. *Skull* (type): Greatest length, 26.3; zygomatic breadth, 14; interorbital breadth, 4.9; width of braincase, 10.6; nasals, 10.1; anterior palatine foramina, 4; palatal bridge, 5.5; upper molar series, 3.8.

Remarks.—The range of *O. guerrerensis* marks the northern limit of the distribution of the *O. alfaroi* group along the western slope of the mountains bordering the Pacific coast of Mexico. As in other southern groups, the general range of *O. alfaroi* and its allies seems to bifurcate north of the Isthmus of Tehuantepec, the forms which pass farther to the northward along the eastern and western slopes of the interior plateau region being isolated and developing differential characters. The ranges of *O. guerrerensis* and *O. a. chapmani* appear to be completely separated, and while these forms differ appreciably in numerous details, they agree rather closely in the more essential features, and may prove to intergrade through the much larger form *O. a. caudatus.* The latter, however, as at present understood, exhibits so wide a departure from *guerrerensis* that close comparison seems unnecessary.

Specimens examined.—Total number, 8, as follows:

Guerrero: Omilteme, 6 (type and topotypes).
Oaxaca: Pluma, 2.

ORYZOMYS HYLOCETES Merriam.

Chiapas Rice Rat.

(Pl. III, figs. 8, 8a.)

Oryzomys hylocetes Merriam, Proc. Washington Acad. Sci., III, p. 291, July 26, 1901.

Type locality.—Chicharras, Chiapas, Mexico (altitude 3,500 feet).

Type.—No. 77605, ♂ old, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 14, 1896.

Geographic distribution.—Heavily forested Pacific slope, at 3,500 feet, of mountains along continental divide in extreme southern

Chiapas, and doubtless adjacent portions of Guatemala; Humid Upper Tropical Zone.

General characters.—Size small; color dark; pelage short; skull short and relatively broad across anterior roots of zygomata. Somewhat similar to *O. a. angusticeps* and *O. a. rhabdops*, but much smaller than either, and cranial characters distinctive.

Color.—About as in *O. a. saturatior.*

Skull.—General form short, with posteriorly narrow braincase and anteriorly divergent zygomata; anterior palatine foramina rather long, but not reaching anterior plane of first molars; molars small. In size the skull is perhaps nearest to that of *O. a. saturatior*, but it differs in the anterior expansion of the zygomata and departs from that of its larger and nearer geographic neighbor *O. a. angusticeps* in the same respect. The skull is similar in general outline, especially the form of zygomata, to that of *O. a. rhabdops*, but very much smaller.

Measurements.—Type: Total length, 217; tail vertebræ, 118; hind foot, 27. *Skull* (type): Greatest length, 26.2; zygomatic breadth, 13.6; interorbital breadth, 4.6; width of braincase, 9.9; nasals, 9.7; anterior palatine foramina, 4.5; palatal bridge, 5.3; upper molar series, 3.5.

Remarks.—Two examples only of *O. hylocetes* are known, one old and in worn pelage, the other very young, and the range of individual variation the form may present can not now be determined. The species inhabits the lower slope of the mountains, while the upper levels of the same range are occupied by *O. a. angusticeps*, a much larger form, with longer pelage and apparently representing a distinct specific type; but only through the accession of new material can the exact relationship of the two be made clear. The skull in general contour bears a striking resemblance to that of the otherwise different Guatemalan form, *O. a. rhabdops.*

Specimens examined.—Two, from type locality.

Oryzomys talamancæ Group.

Geographic distribution.—Forested districts in eastern Costa Rica and Panama, and south in South America at least to southern Brazil; altitudinal range from sea level to 3,000 feet in Panama; Arid and Humid Lower Tropical Zones (fig. 6).

General characters.—Size large; form rather slender; tail about equal to or somewhat exceeding head and body, scantily and indistinctly haired; ears large and conspicuous, thinly clothed externally and internally, with very short, fine, almost microscopic hairs, general pelage short, rather harsh, and lacking the woolly quality of *O. palustris;* vibrissæ about as long as head; toes of hind feet more or less distinctly webbed at base, the longest three bearing conspicuous tufts of silvery bristles which extend beyond the points of the claws; claws short, recurved, compressed, and sharp pointed. Color of upperparts varying from rich ochraceous-tawny to cinnamon brown or russet, lined with black; underparts white or buffy whitish.

Skull.—Size large, with rostrum long and braincase low and somewhat flattened; maxillary arm of zygoma heavy; outer wall of antorbital foramen with projecting border rounded or sloping forward, the antorbital notch rather shallow as viewed from above; nasals and premaxillæ about conterminous posteriorly; frontal region wide, the lateral margins trenchant, a more or less conspicuous depression on median line close to posterior ends of nasals; temporal ridges moderately developed anteriorly along parieto-squamosal sutures, becoming indistinct posteriorly in crossing lateral wings of parietals; interparietal large; anterior palatine foramina short and broad, much shorter than palatal bridge, not reaching anterior plane of first molars; palatal pits small; spheno-palatine vacuities small; interpterygoid fossa broad; audital bullæ small, the inner sides largely overlapped by mastoids; basi-occipital broad; angle of mandible moderately broad, the inferior border strongly turned inward; coronoid process rather short and low; molars moderately heavy; the inner reentrant angles in upper molars and outer reentrant angles in lower molars, deeply cutting the crowns; mandibular tooth row decidedly narrower posteriorly than anteriorly; tubercle over root of lower incisor weakly developed. Contrasted with those of the *O. palustris* group, skulls of *O. talamancæ* and its allies differ especially in greater length of rostrum, shorter anterior palatine foramina in relation to length of palatal bridge, smaller size of audital bullæ, and in dental detail; the upper molars are more deeply cleft by inner reentrant angles and the lower molars by outer reentrant angles; the second upper molar differs especially in the more nearly equal size of the protocone and hypocone (protocone larger than hypocone in *palustris*), owing to more central position of inner reentrant angle, and in the absence of the large, elongated enamel island extending, in the moderately worn tooth of *palustris*, along the postero-internal base of the paracone, or the reduction of this island to a smaller one, appearing in *talamancæ* near the mesostyle; the third lower molar is more triangular in outline than in *palustris*, the posterior division being decidedly narrower than the anterior.

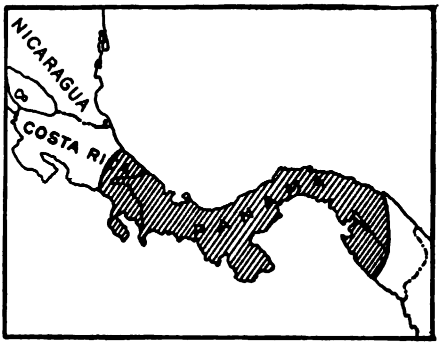

FIG. 6.—Geographic distribution of *Oryzomys talamancæ*.

Remarks.—The group name used is that of the single North American species, *O. talamancæ* of Costa Rica. This species typifies a series of wide distribution in South America; *O. mollipilosus* and *O. medius* are closely allied Colombian and Venezuelan forms, and others of this unrevised group range far south in Brazil.

The *O. talamancæ* group is more nearly related to the *O. bombycinus* group than to any other North American section of the genus, and representatives of the two sometimes share the same local habitat. Members of the *talamancæ* group are externally separable by the shortness of their pelage, while the heavier rostrum and the extension of the lateral wings of the parietals below the temporal ridges are distinguishing cranial characters. In dentition the two groups agree very closely.

ORYZOMYS TALAMANCÆ Allen.

Talamanca Rice Rat.

(Pl. IV, figs. 3, 3a; Pl. V, fig. 7; Pl. VI, figs. 4, 4a.)

Oryzomys talamancæ Allen, Proc. U. S. Nat. Mus., XIV, p. 193, July 24, 1891.

Oryzomys panamensis Thomas, Ann. Mag. Nat. Hist., ser. 7, VIII, p. 252, September, 1901. Type from City of Panama, Panama. No. 0.5.1.67, ♀, British Mus.; collected by E. André, February 25, 1899.

Oryzomys carrikeri Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 656, October 13, 1908. Type from Rio Sicsola, Talamanca, Costa Rica. No. 25976, ♀ ad., Amer. Mus. Nat. Hist.; collected by M. A. Carriker, jr., August 18, 1904.

Type locality.—Talamanca, Costa Rica (probably near Sipurio, in the valley of the Rio Sicsola).

Type.—No. $\frac{12222}{22742}$, ♂ adult (molars much worn), United States National Museum; collected by W. M. Gabb.

Geographic distribution.—Heavily forested regions from eastern Costa Rica eastward through Panama to near Colombian frontier; altitudinal range from sea level to 3,000 feet; Arid and Humid Lower Tropical Zones.

General characters.—Externally similar to *O. mollipilosus* of South America; skull narrower. (For additional general characters see under *O. talamancæ* group.)

Color.—General color of upperparts varying from pale ochraceous-tawny to cinnamon brown or russet, becoming lighter and in some specimens ochraceous-buffy on cheeks, shoulders, and sides; underparts dull white or buffy whitish, the plumbeous basal color showing through; ears brownish, indistinctly clothed externally with very short dusky hairs and internally with almost microscopic buffy or grayish hairs; feet (epidermis) dull yellowish, thinly covered above with short glossy white hairs, the hind feet with tufts of silvery bristles projecting beyond claws of longer digits; tail (epidermis) dark brownish above, varying from light brownish to dull yellowish.

Skull.—About like that of *O. mollipilosus*, but braincase and frontal region decidedly broader.

Measurements.—Type (dry skin): Total length, 233; tail vertebræ, 115; hind foot, 30. Average of three adults from Rio Sicsola, Costa Rica: 251 (240–265); 124 (118–133); 29.8 (29–30. 5). *Skull* (type): Greatest length, 31.5; zygomatic breadth, 15.5; interorbital breadth, 5.3; width of braincase, 11.2; nasals, 12.8; anterior palatine foramina, 4.3; palatal bridge, 7.1; upper molar series, 4.6.

Remarks.—Specimens from the Canal Zone and as far east as extreme eastern Panama seem referable to typical *O. talamancæ* of Costa Rica. Two examples from Gatun, Canal Zone, have been submitted to Mr. Oldfield Thomas for comparison with the type of "*O. panamensis*" in the British Museum. The result of his examination he has kindly written as follows: "We have only one specimen of *O. panamensis* [the type] and it is both larger and more rufous than your specimens. But it is older; the skull agrees in general characters and the toothrow is of exactly the same length. As to the colour I think the difference is only due to the coming on of the faded fulvous stage found in the old specimens of most species of *Oryzomys*. Personally I should certainly refer your specimens to *panamensis*." Since the examples used for comparison are regarded as fairly typical of *talamancæ* I conclude that *panamensis* must be placed in the synonymy of that species.

The type and two topotypes of "*O. carrikeri*" Allen agree essentially with the type of *talamancæ*. The exact locality of the latter is not definitely known, but Gabb, the collector, worked mainly near Sipurio and probably secured the specimen there. The Carriker collection came from about halfway between Cuabre and the mouth of the Rio Sicsola, the two localities being, on this assumption, not far apart in the same river valley.

The ranges of *talamancæ* and *O. alfaroi* overlap, and owing to their superficial resemblance the two have sometimes been confused; *talamancæ* is a larger animal than *alfaroi*, with a longer hind foot. The skulls, however, present the safest distinguishing characters, that of *talamancæ* being more massive, with heavier maxillary arms of zygomata, and heavier dentition; the first and second upper molars, besides differing in details of crown arrangement, are more deeply cleft by inner reentrant angles and all the lower molars by outer reentrant angles, while in *alfaroi* they more nearly approach the condition shown in *O. palustris*.

Specimens examined.—Total number, 20, as follows:

Costa Rica: Boruca, 1;[1] Rio Sicsola, 3 (including type of "*carrikeri*");[2] Talamanca, 1 (type).

Panama: Cana, 7; Cerro Brujo, 1; Divala, 1;[1] Gatun, 6.

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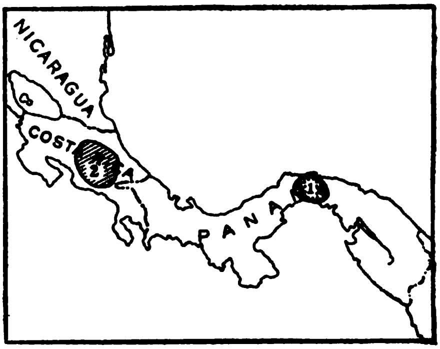
[1] Collection Mus. Comp. Zool.

[2] Collection Amer. Mus. Nat. Hist.

Oryzomys bombycinus Group.

Geographic distribution.—Forested regions from southern Costa Rica south through Panama at least to northern Ecuador; altitudinal range from near sea level to at least 3,000 feet; Humid Lower Tropical Zone (fig. 7).

General characters.—Size large; form rather slender; tail about equal to or slightly longer than head and body, scantily and very indistinctly haired; pelage of upperparts very long (that of back measuring about 12 mm.), underfur not woolly as in *O. palustris;* supraorbital vibrissæ 50 to 70 mm. in length (exceeding those arising from the muzzle), reaching posteriorly to sides of body; ears rather large and naked appearing, the short, fine hairs scattered over inner and outer surfaces almost microscopic; hind feet slender, very scantily haired above, the plantar surface generally smooth, but in some examples indistinctly granular between interdigital tubercles; toes of hind feet more or less distinctly webbed at base, the longest three bearing conspicuous tufts of silvery bristles projecting beyond ends of claws as in the *O. talamancæ* group; claws short, recurved, compressed, and sharp pointed. Colors dark; upperparts near cinnamon brown or russet; underparts overlaid with dull white.



1. *O. b. bombycinus.* | 2. *O. b. alleni.*

FIG. 7.—Geographic distribution of subspecies of *Oryzomys bombycinus.*

Skull.—Size rather large, with rostrum long and narrow, the nasals attenuate and slightly exceeding premaxillæ in posterior extent; braincase broad and moderately expanded; zygomata slender; outer wall of antorbital foramen with projecting upper anterior border well rounded, the antorbital notch broad but not deeply cutting zygoma as viewed from above; frontal region moderately broad and somewhat flattened, the small depression on median line near anterior border deep and conspicuous, and more or less involving ends of nasals; lateral margins of frontals rising in distinct, but narrow, compressed ridges; temporal ridges well developed, bounding parietals laterally as far as lateral extension of supraoccipital, where they turn abruptly and are continued downward along the anterior border of that segment; parietals without lateral wings extending across temporal ridges; interparietal large, reaching transversely nearly across posterior parietal border; anterior palatine foramina short, not reaching anterior plane of first molars; palatal pits small; spheno-palatine vacuities very small or absent; interpterygoid fossa broad; audital bullæ small; basi-occipital broad; angle of mandible broad, the inferior border strongly turned inward; coronoid process rather large and broad across base; molars moderately heavy, the crown arrangement of the *O. talamancæ* type, the crowns deeply incised by reentrant angles and the mandibular toothrow much narrower posteriorly; second upper molar about as in *talamancæ*, the elongated enamel island present in *O. palustris*, *O. melanotis* and *O. alfaroi* groups, being absent or displaced by a bending backward of the commissure of the paracone and protocone; third lower molar long and narrow, the large outer reentrant angle extending more than halfway across the crown.

Remarks.—Forms of this group differing only subspecifically among themselves evidently range from Costa Rica to Ecuador and may extend much farther; the group, therefore, seems to be mainly South American in distribution. Owing to lack of definite knowledge of the relationships of the South American forms it seems best to treat the North American representatives as specifically distinct until a revision of the South American species can be undertaken.

In many important characters, especially of the skull and dentition, the *O. bombycinus* group approaches the *O. talamancæ* group and the two sometimes occur together in the same localities. The *bombycinus* group is easily recognizable externally by the much greater length of the pelage, while the skull is sufficiently distinguished by the slender rostrum and the absence of the lateral wings of the parietals, which in the *talamancæ* group extend across the temporal ridges at the expense of the squamosals. Unlike many groups of the genus which show a preference for open or partially open situations *O. bombycinus* seems to be at home in the depth of the forest.

ORYZOMYS BOMBYCINUS Goldman.

[Synonymy under subspecies.]

Geographic distribution.—Heavily forested areas from southern Costa Rica to eastern Panama, and probably western Colombia; altitudinal range from sea level to at least 3,000 feet; Humid Lower Tropical Zone.

General characters.—(See under *O. bombycinus* group).

Color.—General color of upperparts varying from ochraceous-tawny to cinnamon brown or russet finely mixed with black; darkest on face, top of head, and back, the lighter element restricted to tips of hairs and the dark basal color showing through, becoming lighter and approaching ochraceous-buff or pale ochraceous-tawny on cheeks, shoulders, and sides; underparts dull whitish; ears black, the outer and inner sides thinly clothed with very short dusky hairs; feet (epidermis) dull yellowish, the hairs whitish; tail dark brownish above, light brownish below. *Young* (about two-thirds grown): Upperparts blackish, nearly pure black on face, top of head, and back, becoming lighter and more distinctly lined with ochraceous-buffy hairs on cheeks, shoulders, and sides.

Skull.—(See under *O. bombycinus* group.)

Remarks.—Two closely allied forms inhabit Panama and Costa Rica, and may not improbably prove to be geographic races of *O. nitidus* of Peru, since Ecuadorean specimens believed to be near *nitidus* show close alliance to the North American forms.

Key to Subspecies of O. bombycinus.

*a*¹. Braincase less inflated. (Panama.)..................**O. b. bombycinus** (p. 77).
*a*². Braincase more inflated. (Costa Rica.)....................**O. b. alleni** (p. 78).

ORYZOMYS BOMBYCINUS BOMBYCINUS GOLDMAN.

LONG-HAIRED RICE RAT.

(Pl. II, figs. 7, 7a; Pl. V, fig. 8; Pl. VI, figs. 5, 5a.)

Oryzomys bombycinus Goldman, Smiths. Misc. Coll., LVI, No. 36, p. 6, February 19, 1912.

Type locality.—Cerro Azul, near headwaters of Chagres River, Panama (altitude, 2,500 feet).

Type.—No. 171105, ♂ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, March 26, 1911.

Geographic distribution.—Mountains of east-central Panama; altitudinal range from 1,000 to 3,000 feet; Humid Lower Tropical Zone.

General characters.—Size about as in *O. b. alleni*, color identical; skull with much flatter, less expanded braincase.

Color.—(See under *O. bombycinus.*)

Skull.—Similar to that of *O. b. alleni*, but braincase lower, flatter, much less distended, especially anteriorly; frontal region narrower posteriorly.

Measurements.—Type: Total length, 252; tail vertebræ, 127; hind foot, 32. *Skull* (type and adult topotype): Greatest length, 31.3, 31.7; zygomatic breadth, 15.4, 16.1; interorbital breadth, 5.5, 5.4; width of braincase, 11.2, 11.6; nasals, 12.2, 12.2; anterior palatine foramina, 5, 4.5; palatal bridge, 6.2, 6.1; upper molar series, 4.7, 4.4.

Remarks.—The Panama form apparently differs from the Costa Rican animal only in cranial characters, and the specimens on which it is based closely resemble Ecuadorean examples believed to be near *O. nitidus*. The four Panama specimens are very slightly paler in color than five from Ecuador, with skulls also similar, but the zygomata more strongly bowed outward, the sides less nearly parallel.

Specimens examined.—Total number, 4, as follows:

Panama: Cerro Azul, 3 (type and topotypes); Cerro Brujo, 1.

ORYZOMYS BOMBYCINUS ALLENI GOLDMAN.

ALLEN RICE RAT.

(Pl. II, figs. 8, 8a.)

Oryzomys nitidus alleni Goldman, Proc. Biol. Soc. Washington, XXVIII, p. 128, June 29, 1915.

Type locality.—Tuis (about 35 miles east of Cartago), Costa Rica.

Type.—No. $\frac{9631}{7971}$, ♂ subadult (teeth slightly worn), American Museum of Natural History; collected by George K. Cherrie, July 15, 1894.

Geographic distribution.—Mountainous portions of southern Costa Rica; altitudinal range from 800 to about 2,000 feet; Humid Lower Tropical Zone.

General characters.—Size about as in *O. b. bombycinus;* color identical; skull with braincase higher, much more fully expanded.

Color.—As in *O. b. bombycinus.* (See under *O. bombycinus* group.)

Skull.—Similar to that of *O. b. bombycinus*, but braincase higher, more arched, much more distended, especially anteriorly; frontal region broader posteriorly.

Measurements.—Type (young): Total length, 218; tail vertebræ, 111, hind foot, 29. *Skull* (type): Greatest length, 28.2; zygomatic breadth, 14.3; interorbital breadth, 5.5; width of braincase, 11.6; nasals, 10.9; anterior palatine foramina, 3.5; palatal bridge 5.5; upper molar series, 4.3.

Remarks.—Cranial comparisons are necessary in order to distinguish this Costa Rican form from *O. b. bombycinus* of Panama. While the interorbital breadth is about the same, the greater anterior expansion of the braincase has resulted in broadening the posterior part of the frontal region.

Specimens examined.—Total number, 4, as follows

Costa Rica: Tuis, 3 (type and topotypes); Guapiles, 1.[1]

Oryzomys devius Group.

Geographic distribution.—High mountains of central Costa Rica to Colombia and Venezuela; altitudinal range from 4,000 to at least 5,000 feet; Humid Upper Tropical Zone (fig. 8).

General characters.—Size very large, but form rather slender; tail much longer than head and body, indistinctly haired; ears rather large, blackish, the short hairs, thinly distributed over inner and outer sides, of about the same color as the epidermis; pelage long, but somewhat rigid; vibrissæ long (about reaching shoulders); hind feet long and narrow, thinly haired above, the plantar surface between the large conspicuous tubercles smooth; toes of hind feet with the slight basal webbing usual in the genus, the longest three tufted with silvery bristles as in *O. talamancæ* and other groups; claws short, recurved, compressed and sharp pointed as in other partially scansorial sections of the genus. Colors dark; upperparts between tawny and russet; underparts varying from ochraceous-tawny to dull white, the basal color plumbeous except in some examples, which tend to exhibit irregular areas on throat where the fur may be pure white to roots.

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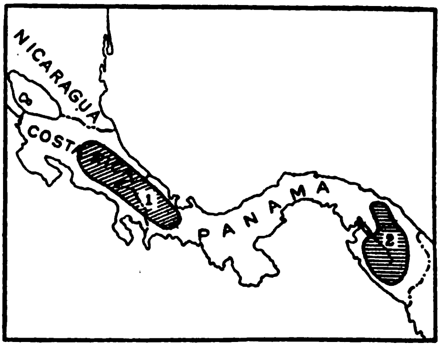
[1] Collection Carnegie Mus.

Skull.—Size very large, with rostrum long and heavy; nasals broad and reaching posteriorly slightly beyond premaxillæ; braincase moderately broad and inflated; zygomata heavy; the maxillary arm extensively overlapping outer side of jugal, in some examples in contact with squamosal, the gap usual in the genus being completely bridged; outer wall of antorbital foramen with projecting upper anterior border rounded, the antorbital notch broad as viewed from above, but less deeply cutting zygoma, the aperture appearing less evenly circular than in the *O. palustris* group; frontal region narrow, especially posteriorly, the anterior median depression rather inconspicuous; lateral margins of frontals smoothly rounded, or rising in slightly upturned ridges; temporal ridges moderately developed, crossing lateral wings of parietals to supraoccipital and continuing thence downward in prominent crests along occipito-squamosal border; interparietal very large, extending transversely nearly across posterior parietal border, pointed-elliptical in outline owing to convexity of anterior margin; anterior palatine foramina very short, not reaching anterior plane of first molars, narrow anteriorly, very broad and gaping widely open posteriorly, palatal pits large and irregular in form; spheno-palatine vacuities absent; interpterygoid fossa moderately broad and extending well forward, the anterior border closely approaching posterior plane of last molars; audital bullæ variable but rather small; angle of mandible broad, the inferior border strongly incurved; coronoid process large and strongly upturned, the high thin connecting ridge extending to near summit of condyle; molars heavy and approaching the *O. talamancæ* type, the crowns of the upper series deeply incised by inner reentrant angles, and of lower series by outer reentrant angles; as in the *talamancæ* group the second upper molar is evenly cleft by inner reentrant angle and lacks



1. *O. devius.* | 2. *O. pirrensis.*

FIG. 8.—Geographic distribution of the *Oryzomys devius* group.

the elongated enamel island extending in the moderately worn crown of *O. palustris* and other groups along the postero-internal base of the paracone; mandibular toothrow very narrow posteriorly, the third molar elongated and deeply cleft by outer reentrant angle.

Remarks.—The *O. devius* group, as it may be called, includes two northern representatives of a widely distributed South American section of the genus which in that country has sometimes been denominated the *O. meridensis* group, from the name of a Venezuelan species.

These northern forms generally lack the irregular but extensive pure white pectoral and inguinal areas exhibited by the allied Venezuelan and Colombian forms *O. meridensis* and *O. maculiventer*, although a tendency to develop them is shown in *O. devius*.

The North American species are externally easily recognizable among their congeners of the general region by the combination of large size with dark color and very long tails. Except for the more hispid pelage they are superficially much like the species of *Peromyscus* (subgenus *Megadontomys*) occurring at the same localities with them.

Key to Species of the O. devius Group.

a^1. Supraorbital ridges prominent. (Eastern Panama.)........**O. pirrensis** (p. 81).
a^2. Supraorbital ridges not prominent. (Western Panama.).......**O. devius** (p. 80).

ORYZOMYS DEVIUS BANGS.

CHIRIQUI RICE RAT.

(Pl. IV, figs. 1, 1a.)

Oryzomys devius Bangs, Bull. Mus. Comp. Zool., XXXIX, p. 34, figs, 13, 14, April, 1902.

Type locality.—Boquete, Volcan de Chiriqui, Panama (altitude, 5,000 feet).

Type.—No. 10324, ♀ adult, Museum of Comparative Zoology (Bangs collection); collected by W. W. Brown, jr., January 29, 1901.

Geographic distribution.—Forested slopes of high mountains in central Costa Rica and western Panama; altitudinal range from 4,000 to at least 5,000 feet; Humid Upper Tropical Zone.

General characters.—Size large, about as in *O. pirrensis* of eastern Panama, but color slightly paler, more tawny; skull more smoothly rounded; audital bullæ much larger.

Color.—Upperparts dark tawny, inclining toward russet and rather heavily mixed with black along median line of dorsum, becoming light tawny, or in the paler examples dark ochraceous-buffy along lower part of sides; throat whitish (the fur pure white to roots over a small area in one example), rest of underparts overlaid with ochraceous-buffy in three examples and with dull white in the other three examined; nose and ears blackish; feet dull yellowish or light brownish; tail (epidermis) dark brownish above, paler below. *Young* (in first pelage): Upperparts blackish, the tawny element appearing rather inconspicuously along sides; underparts (in single specimen examined) thinly overlaid with dull white.

Skull.—Similar to that of *O. pirrensis*, but more smoothly rounded, the supraorbital and temporal ridges weakly developed or absent; nasals slightly longer, ending posteriorly in plane of lachrymals; zygomata less widely spreading; audital bullæ decidedly larger. Compared with that of *O. meridensis*, the skull is larger, with longer nasals and larger audital bullæ.

Measurements.—Type: Total length, 335; tail vertebræ, 180; hind foot, 33. Two adult topotypes: 345, 360; 185, 195; 36, 35. *Skull* (average of three adults, type, and two topotypes): Greatest length, 36.6 (35.8–37.5); zygomatic breadth, 18.4 (18–19); interorbital breadth, 5.7 (5.5–6); width of braincase, 12.6 (12.2–12.9); nasals, 14.3 (13.8–15); anterior palatine foramina, 5.4 (5.2–5.6); palatal bridge, 7.8 (7.8–7.9); upper molar series, 5.7 (5.6–5.8).

Remarks.—*O. devius* is clearly allied to *O. pirrensis* of eastern Panama, but possesses very distinctive cranial characters, and there is no hint of intergradation. Both are inhabitants of high mountains, and their ranges are apparently separated by the intervening lowlands in the vicinity of the Canal Zone.

Specimens examined.—Total number, 8, as follows:

Costa Rica: Volcan Irazu, 2.[1]
Panama: Boquete, 6 (type and topotypes).[2]

ORYZOMYS PIRRENSIS Goldman.

Mount Pirre Rice Rat.

(Pl. IV, figs. 2, 2a; Pl. V, fig. 9; Pl. VI, figs. 6, 6a.)

Oryzomys pirrensis Goldman, Smiths. Misc. Coll., LX, No. 22, p. 5, February 28, 1913.

Type locality.—Head of Rio Limon, Mount Pirre, Panama (altitude 4,500 feet).

Type.—No. 178993, ♂ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, April 29, 1912.

Geographic distribution.—Steep, heavily forested slopes of high mountains at 4,500 feet altitude in eastern Panama, and probably adjacent portions of Colombia; Humid Upper Tropical Zone.

General characters.—Size large, about as in *O. devius* of western Panama, but color slightly darker, more russet; skull more angular; audital bullæ decidedly smaller.

Color.—*Fresh pelage:* Upperparts between tawny and russet, heavily mixed with black along the broad median line from top of head to base of tail, becoming lighter, purer tawny on cheeks, shoulders, and sides; throat whitish or grayish, rest of underparts usually overlaid with ochraceous-tawny, but varying to dull white, the basal color of the fur everywhere deep plumbeous; nose and ears blackish; fore feet blackish, becoming lighter on toes; hind feet dark brown, thinly clothed with short hairs to toes, the toes dull yellowish; epidermis of tail dark brown above, usually somewhat paler below. *Young* (in first pelage): Upperparts darker than in adults, the blackish element in the pelage predominant; underparts with a thinner ochraceous-tawny wash.

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[1] One specimen in Mus. Comp. Zool.

[2] Four specimens in Mus. Comp. Zool.; 2 in Field Mus. Nat. Hist.

Skull.—Similar to that of *O. devius*, but more angular, the supraorbital and temporal ridges well developed; nasals slightly shorter, not reaching posteriorly to plane of lachrymals; zygomata more widely spreading; audital bullæ decidedly smaller. In small size of audital bullæ the skull agrees with those of *O. meridensis* and *O. maculiventer*, but contrasts with both in larger general size and angularity.

Measurements.—Type: Total length, 340; tail vertebræ, 185; hind foot, 38. Average of five adult topotypes: 314 (309–322); 164 (159–170); 35.7 (34–37). *Skull* (average of six adults, type, and five topotypes): Greatest length, 36.8 (34.9–38.5); zygomatic breadth, 19.2 (17.8–20); interorbital breadth, 5.8 (5.5–6); width of braincase, 12.4 (11.8–12.9); nasals, 13.7 (13–14); anterior palatine foramina, 5.8 (5.4–6); palatal bridge, 7.5 (7.3–7.8); upper molar series, 5.7 (5.5–5.9).

Remarks.—In external appearance *O. pirrensis* differs only slightly from *O. devius* of western Panama. The skull, however, combines the large general size of that species with the smaller general dimensions and small audital bullæ of *O. meridensis* and *O. maculiventer;* it differs from both in the development of the supraorbital and temporal ridges. In color of upperparts *O. pirrensis* is similar to the South American species, but the underparts show no trace of the pure white pectoral and inguinal areas which are so conspicuous in the latter forms.

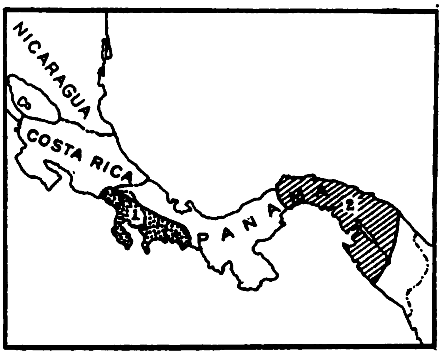
Specimens examined.—Eight, from type locality.

Oryzomys tectus Group.

Geographic distribution.—Southern Costa Rica and southeastward through Panama at least to Colombia and Venezuela; altitudinal range from near sea level to about 5,000 feet (fig. 9).

General characters.—Size large, form rather robust; tail about equal to or somewhat exceeding head and body, scantily haired, the epidermal scales small; ears small, moderately clothed externally and internally with comparatively coarse hairs of general body color; general pelage long, coarse, and rigid; vibrissæ somewhat longer than head; hind feet short and relatively broad, well haired above, the longest three toes bearing conspicuous tufts of silvery bristles, whiproject beyond ends of claws; claws short, strongly curved, compressed, and sharp-pointed. Color of upperparts between rich tawny and ochraceous-tawny, mixed with black, the tawny element predominating; underparts varying from nearly pure white to warm buff.

Skull.—Size large and angular, with rostrum short and braincase low and flattened; outer wall of antorbital foramen rounded above, the forward projection moderate; nasals short, ending posteriorly in the anterior plane of orbits; premaxillæ about conterminous with nasals posteriorly, the ends slightly expanded, not beveled externally; frontals very broad, the lateral margins overhanging as supraorbital shelves; temporal ridges prominent, extending posteriorly to supraorbital border; mastoid process of squamosal short and stout, owing to slight excision of squamosal margin; interparietal large, pointed-elliptical, the anterior angle well developed; lachrymal very small; anterior palatine foramina short, moderately broad anteriorly and posteriorly, reaching or nearly reaching anterior plane of first molars; palatal pits normally small; sphenopalatine vacuities absent or very small; audital bullæ small; ramus of mandible short, the angle broad; coronoid process broad and strongly hooked, a high trenchant ridge connecting with condyle; tubercle over root of lower incisor large. Molars similar to those of the *O. talamancæ* group; approaching the *O. palustris* type in general characters, but second upper molar with inner lobes more nearly equal in extent (the anterior slightly the larger in *palustris*), and central enamel island present in *palustris* usually fused with enamel fold separating paracone and parastyle; third lower molar more triangular in outline, the posterior lobe narrower and the outer reentrant angle more nearly dividing crown.



1. *O. t. tectus.* | 2. *O. t. frontalis.*

FIG. 9.—Geographic distribution of subspecies of *Oryzomys tectus.*

Remarks.—*O. tectus* is typical of a group including also *O. flavicans*, *O. palmarius*, and other extralimital forms distinguished by rich coloration, coarsely haired ears, and short stout hind feet. In external appearance they are not very unlike some species of *Rhipidomys*, but have shorter, less hairy tails and lack the dark metapodial markings usually present in that genus; in general characters they apparently approach the section assigned to generic rank by Thomas under the name *Œcomys*,[1] but in the more essential respects scarcely exhibit a wider departure from typical *Oryzomys* than several groups usually assigned to the genus.

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[1] Thomas, Oldfield, Ann. Mag. Nat. Hist., ser. 7, XVIII, p. 444, Dec. 1906.

ORYZOMYS TECTUS THOMAS.

[Synonymy under subspecies.]

Geographic distribution.—Southern Costa Rica, Panama, and probably adjacent portions of Colombia; vertical range from near sea level to about 2,000 feet, mainly in Arid Lower Tropical Zone.

General characters.—Similar to *O. flavicans* of Venezuela, but larger; color darker; skull larger with laterally expanded frontal region. (For additional general characters see under *O. tectus* group.)

Color.—*Fresh pelage:* General color of upperparts varying shades of tawny and ochraceous-tawny, rather inconspicuously darkened on face, top of head, and back by an admixture of dusky hairs, becoming paler, more ochraceous-buffy on cheeks, shoulders, and sides; underparts varying from near pure white to warm buff; ears clothed internally and externally with short tawny hairs; feet whitish; tail varying from uniform dark brownish all around to dark brownish above, and whitish or yellowish below.

Skull.—Size large, with remarkably broad frontal region. Similar in general to *O. flavicans*, but decidedly larger; frontal region broader, the lateral margins shelving farther over orbits, not strongly upturned as in *flavicans*. (For additional characters see under *O. tectus* group.)

Remarks.—*O. tectus* is clearly allied to *O. flavicans flavicans*, *O. f. illectus*, and *O. palmarius*, all South American forms in which the supraorbital ridges are well developed, but are compressed and not widely expanded and *Tylomys*-like as in the forms of *tectus*. This difference, although rather striking, is a relative instead of absolute character, and close agreement in other essential respects even suggests probable intergradation.

Key to Subspecies of O. tectus.

*a*¹. Upperparts more distinctly tawny. (Western Panama and southern Costa Rica.)..**O. t. tectus** (p. 84).
*a*². Upperparts less distinctly tawny. (Eastern Panama.).....**O. t. frontalis** (p. 85).

ORYZOMYS TECTUS TECTUS THOMAS.

BUGABA RICE RAT.

Oryzomys tectus Thomas, Ann. Mag. Nat. Hist., ser. 7, VIII, p. 251, September, 1901.

Type locality.—Bugaba, Chiriqui, Panama (altitude 800 feet).

Type.—No. 0.7.11.43, ♂, British Museum; collected by H. J. Watson, September 15, 1898.

Geographic distribution.—Pacific slope of western Panama and southern Costa Rica at about 800 feet altitude, limits of altitudinal range unknown; Arid Lower Tropical Zone.

General characters.—Closely resembling *O. t. frontalis*, but upperparts richer tawny; underparts more extensively buffy; lips, chin, and throat buffy instead of white as in *frontalis;* skull differing in rather slight details.

Color.—Upperparts near tawny rather thinly mixed with black, general color darkest over dorsum, becoming paler and rich ochraceous-buffy on cheeks and sides; underparts, including lips, chin, and throat overlaid with warm buff; ears clothed with tawny hairs; feet whitish; tail (epidermis and hairs) brownish above, whitish or dull yellowish below to near tip, which is dark all around.

Skull.—Very similar to that of *O. t. frontalis*, but frontals more extended posteriorly on median line between parietals; interparietal smaller.

Measurements.—From original description of type: "Head and body, 140 millim.; tail, 142; hind foot, s. u. 27, c. u. 29.5; ear, 18. *Skull:* Tip of nasals to back of interparietal, 33; greatest breadth, 17; nasals, 11.6×4; interorbital breadth, 6.5; palate length, 13.8; diastema 8.1; palatal foramina, 5×2.2; length of upper molar series, 4.9." A rather young example from Boruca, Costa Rica: Total length, 258; tail vertebræ, 140; hind foot, 27.

Remarks.—The type of *O. t. tectus* has not been examined by me, but specimens from Boruca, Costa Rica, are believed to be typical. They are distinguished from *O. t. frontalis* of eastern Panama mainly by richer general coloration. No other member of the *O. tectus* group ranges so far into the Central American Subregion.

Specimens examined.—Two, as follows:

Costa Rica: Boruca, 2.

ORYZOMYS TECTUS FRONTALIS GOLDMAN.

COROZAL RICE RAT.

(Pl. IV, figs. 4, 4a; Pl. V, fig. 10; Pl. VI, figs. 7, 7a.)

Oryzomys frontalis Goldman, Smiths. Misc. Coll., LVI, No. 36, p. 6, February 19, 1912.

Type locality.—Corozal, Canal Zone, Panama (altitude 100 feet).

Type.—No. 171531, ♀ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, June 20, 1911.

Geographic distribution.—Forested Pacific slope of Panama from the Canal Zone to near Colombian frontier, and probably adjacent Colombian territory; altitudinal range from sea level to about 2,000 feet; Arid and Humid Lower Tropical Zones.

General characters.—Similar in general to *O. t. tectus*, but upperparts duller, less distinctly tawny; underparts less extensively buffy; lips, chin, and throat white instead of buffy as in *tectus;* skull differing in rather slight details.

Color.—Upperparts between tawny and ochraceous-tawny, rather sparingly mixed dorsally with black, the general color becoming paler, purer, and ochraceous-buffy on cheeks and sides; underparts in general white in some examples, thinly overlaid with warm buff across the abdomen in others, the lips, chin, and throat in all specimens examined nearly pure white to roots of hairs; ears and feet as in *O. t. tectus;* tail usually unicolor, dark brownish, but in some examples becoming lighter on under side near base.

Skull.—Closely resembling that of *O. t. tectus*, but frontals less extended posteriorly on median line between parietals; interparietal larger.

Measurements.—Type: Total length, 309; tail vertebræ, 161; hind foot, 30. Average of five adults from Cana, Panama: 288 (281–293); 156 (152–164); 27.8 (26.5–29). *Skull* (average of same): Greatest length, 32.8 (31.1–34.1); zygomatic breadth, 17.1 (16.6–17.5); interorbital breadth, 6.1 (5.3–6.8); width of braincase, 12.2 (12–12.6); nasals, 11.4 (10.5–12.4); anterior palatine foramina, 5.3 (4.9–5.6); palatal bridge, 6.4 (5.6–6.9); upper molar series, 5.2 (4.8–5.3).

Remarks.—Two specimens of *O. t. frontalis* from eastern Panama have been submitted to Mr. Oldfield Thomas, who has kindly compared them with the type and topotypes of *O. t. tectus* in the British Museum. While inclined to regard them as referable to the same form he writes that "they are not quite so rich in colour as our specimens." Two examples from Boruca, Costa Rica, not far from the type locality and in the same general faunal area, and believed to be fairly typical of *tectus*, exhibit a type of coloration and slight cranial details indicating that eastern and western Panama are inhabited by closely allied but easily recognizable forms.

Specimens examined.—Total number, 12, as follows:

Canal Zone: Corozal, 1 (type).
Panama: Cana, 11.

ORYZOMYS VICTUS[1] THOMAS.

ST. VINCENT RICE RAT.

Oryzomys victus Thomas, Ann. Mag. Nat. Hist., ser. 7, I, p. 178, February, 1898.

Type locality.—St. Vincent, Lesser Antilles.

Type.—No. 97.12.26.1, ♀ adult, British Museum; collected by H. H. Smith, presented by F. DuCane Godman.

Geographic distribution.—Known only from St. Vincent.

General characters.—From original description of type: "Size and proportions about as in the larger members of the *O. longicaudatus* group. General colour dark rufous, but evidently affected by the spirit in which the specimen has been preserved. Under surface buffy white, the bases of the hairs slate-colour. Eyes without darker rims. Ears short, the anterior part of their backs brown, not strikingly contrasting with the general colour of the head. Hands and feet thinly clothed with fine silvery hairs. Tail almost naked, brown above, slightly paler below. Mammæ 2–2 = 8."

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[1] Group association undetermined.

Skull.—From original description of type: "Skull with the general shape of the South-American *O. longicaudatus*, the braincase being similarly lengthened as compared with the broadened braincase of the Central-American *O. melanotis* and its allies. Compared with a Rio Janeiro example it is larger, more rounded, the supraorbital edges less sharply square, but the parietal ridges thicker and better developed. Molars larger and stouter, palate ending only just behind the back of m^3."

Measurements.—From original description of type (measured in spirit): "Head and body, 96 millim.; tail, 121; hind foot without claws, 25; with claws, 26.7; ear, 14. *Skull:* Basilar length, 21.4; basal length, 23.8; greatest breadth, 15.1; nasals, 11.2x3.4; interorbital breadth, 4.5; interparietal, 3.2x10; palate length from henselion, 12.3; diastema, 7.8; palatal foramina, 5.4x1.8; length of upper molar series, 4.1."

Remarks.—The type of *O. victus* has not been examined by me. It was originally compared mainly with a South American species, but the true affinities remain to be determined. As in the case of *O. antillarum*, of Jamaica, this rice rat seems likely to be endangered by the presence of the mongoose, if it has not already been exterminated since the introduction of that indiscriminately destructive animal.

Subgenus OLIGORYZOMYS Bangs.

Oligoryzomys Bangs, Proc. New England Zool. Club., I, p. 94, February 23, 1900 (subgenus). Type *Oryzomys navus* Bangs.

Geographic distribution.—Southern Mexico south through Central America to undetermined limits in South America.

Subgeneric characters.—Size very small; hind foot usually less than 25; form slender and *Reithrodontomys*-like; ears rather large and coarsely haired; tail much longer than head and body; four longer toes of hind feet bearing tufts of silvery bristles projecting beyond ends of claws.

Skull delicate in structure, smoothly rounded; supraorbital and temporal ridges absent; interorbital region narrow, the constriction about equal to width of rostrum between antorbital foramina; outer wall of antorbital foramen projecting slightly forward, as viewed from above; angle of mandible placed well within vertical plane of condyle; molars with small accessory cusps present as in subgenus *Oryzomys*, but reentrant angles usually broader, the salient angles formed by worn crowns of tubercles less evenly rounded; upper molars early exhibiting small, circular central enamel islands which persist until obliterated by wear in extreme old age; second upper molar with protocone and hypocone of about equal size, the inner reentrant angle central in position; third lower molar with outer reentrant angle extending less than halfway across crown; tubercle over root of lower incisor large.

Remarks.—The subgenus *Oligoryzomys* includes a series of forms easily distinguishable among their North American congeners by diminutive size and external resemblance to species of the genus *Reithrodontomys*. *Oligoryzomys*, however, departs from the subgenus *Oryzomys*, as currently restricted, mainly in a combination of relative rather than absolute characters. The molar crowns differ in details of enamel arrangement, the second upper especially, in the early appearance of a single, persistent, normally circular enamel island in the broad central space between the apex of the inner reentrant angle and the base of the paracone. In the subgenus *Oryzomys* this molar crown varies in pattern; the more typical forms normally present, in early stages of wear, an elongated, crescentic enamel island in the central space, but in more divergent forms the enamel island may be absent or tend to unite with the long, deep enamel fold between the paracone and parastyle. Several groups seem at least as fully entitled to subgeneric recognition as *Oligoryzomys*, but the problem of further subgeneric divisions can best be solved when more comprehensive study of the genus is undertaken.

ORYZOMYS FULVESCENS (SAUSSURE).

[Synonomy under subspecies.]

Geographic distribution.—From southern Mexico south through Guatemala, Honduras, Nicaragua, and Costa Rica to Panama, and probably portions of Colombia; altitudinal range from near sea level to about 5,500 feet; mainly Arid and Humid Lower Tropical Zones (fig. 10).

General characters.—(See subgeneric characters under subgenus *Oligoryzomys*.)

Color.—Upperparts varying from light ochraceous-buff to ochraceous-buff or tawny, most intense on rump, palest and purest on cheeks, shoulders, and sides; the face, top of head, and back moderately darkened by blackish hairs; underparts varying from nearly pure white in general to light ochraceous-buff on abdomen, inguinal region, and inner sides of hind limbs; the lips, throat, and fore limbs white; outer sides of ears blackish, inner sides clothed with ochraceous-buffy hairs; vibrissæ black (about as long as head); feet white, the hind feet with tufts of silvery hairs projecting beyond claws of longest four digits; tail dark brownish above, lighter brown or yellowish below, except toward tip, which is dusky all around. *Young* (in first pelage): Usually darker than adults, the ochraceous-buff or tawny element less developed.

Skull.—(See subgeneric characters under subgenus *Oligoryzomys*.)

Remarks.—The North American forms of the subgenus are all referable to a single species whose range probably extends well into South America. They agree closely among themselves in essential characters, and by small size and slender form are sufficiently distinguished from other sections of the genus inhabiting the same region.

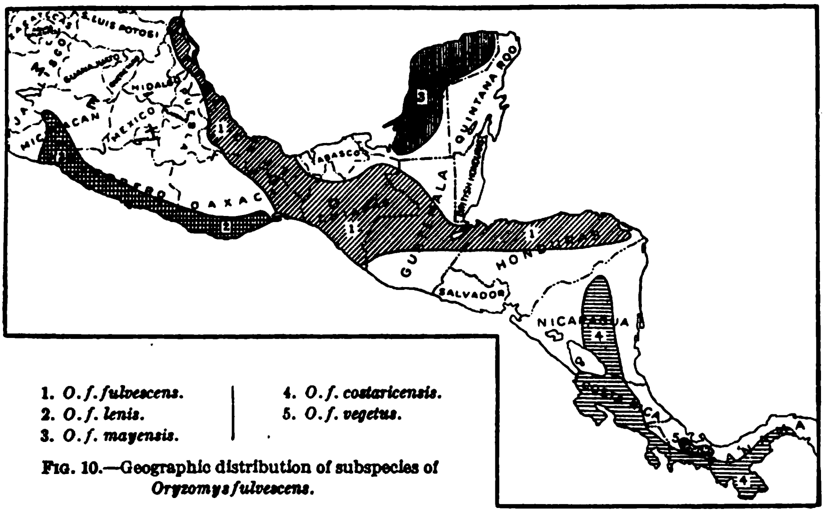

Fig. 10.—Geographic distribution of subspecies of *Oryzomys fulvescens*.

Key to Subspecies of O. fulvescens.

a^1. Size smaller; hind foot less than 24.
  b^1. Upperparts darker ochraceous-buff.
    c^1. Upper molar series shorter. (Southern Tamaulipas; eastern Oaxaca; Chiapas; northern Honduras.)............................ **O. f. fulvescens** (p. 89).
    c^2. Upper molar series longer. (Southwestern Panama; Costa Rica; Nicaragua.) **O. f. costaricensis** (p. 92).
  b^2. Upperparts paler ochraceous-buff.
    c^1. Skull broader; zygomatic breadth 11.5 or more. (Michoacan; Guerrero; southern Oaxaca.)..................................... **O. f. lenis** (p. 91).
    c^2. Skull narrower; zygomatic breadth less than 11.5. (Yucatan; Campeche.) **O. f. mayensis** (p. 92).
a^2. Size larger; hind foot 24 or more. (Mountains of western Panama.) **O. f. vegetus** (p. 93).

ORYZOMYS FULVESCENS FULVESCENS (SAUSSURE).

VERA CRUZ PYGMY RICE RAT.

[Pl. IV, figs. 5, 5a; Pl. V, figs. 2, 11; Pl. VI, figs. 8, 8a.]

Hesperomys fulvescens Saussure, Rev. et Mag. Zool., ser. 2, XII, p. 102, March, 1860.
Oryzomys fulvescens Allen and Chapman, Bull. Amer. Mus. Nat. Hist., IX, p. 204, June 16, 1897.

Type locality.—Orizaba,[1] Vera Cruz, Mexico.

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[1] Type locality fixed by Merriam, Proc. Washington Acad. Sci., III, p. 295, July 26, 1901.

Type.—In Geneva Museum of Natural History.

Geographic distribution.—Southern Tamaulipas, Vera Cruz, eastern Oaxaca, Chiapas, and east through central Guatemala to eastern Honduras; altitudinal range from near sea level to about 5,500 feet; mainly Arid and Humid Lower Tropical Zones.

General characters.—Size small; molar tooth series short. Similar to *O. f. lenis* but upperparts darker ochraceous-buff, the general tone less yellowish; skull narrower and less massive. Size about as in *O. f. costaricensis*, but upperparts usually less tawny; molar series shorter.

Color.—*Fresh pelage:* Upperparts near ochraceous-buff, most intense and in some examples suffused with tawny on rump, palest and purest on cheeks, shoulders, and sides; the face, top of head, and back moderately darkened by blackish hairs; underparts varying from nearly pure white throughout in rare examples to warm buff on abdomen, inguinal area, and inner sides of hind limbs, the white appearing only on lips, chin, and inner sides of hind limbs; outer sides of ears blackish, inner sides clothed with ochraceous-buffy hairs; feet whitish; tail brownish above, yellowish below, except toward tip, which is dusky all around. *Young* (in first pelage): Darker than adults, the ochraceous-buff of upperparts restricted to narrow tips of hairs, thus permitting plumbeous basal color to show through and alter general tone.

Skull.—About like that of *O. f. costaricensis*, but molar tooth series shorter. Contrasted with *O. f. lenis*, the skull is narrower, with less widely spreading zygomata; maxillary arms of zygomata and ascending branches of premaxillæ less broad and heavy.

Measurements.—Average of 10 adults from Orizaba, Vera Cruz: Total length, 174.7 (168–205); tail vertebræ, 107.1 (96–118); hind foot, 22 (21–23). *Skull* (average of same): Greatest length, 21.9 (21.1–22.5); zygomatic breadth, 11.5 (11–11.7); interorbital breadth, 3.5 (3.4–3.9); width of braincase, 9.5 (9.3–9.8); nasals, 7.9 (7.6–8.3); anterior palatine foramina, 3.5 (3.3–3.6); palatal bridge, 3.7 (3.5–4); upper molar series, 2.9 (2.9–3).

Remarks.—The differential characters are rather slight, and *O. f. fulvescens* may safely be assumed to intergrade with *O. f. lenis* near the Pacific coast in the vicinity of the Isthmus of Tehuantepec, with *O. f. costaricensis* in eastern Honduras or western Nicaragua, and with the paler form inhabiting the Yucatan Peninsula, in southern Campeche. A single specimen from Patuca, Honduras, the only one available from that country, has a short molar series and seems referable to the subspecies *fulvescens*, the known range of which is thus materially extended eastward from western Guatemala.

Specimens examined.—Total number, 73, as follows:

Chiapas: Huehuetan, 4; Ocuilapa, 1; Tumbala, 11; Yajalon, 1.

Guatemala: Jacaltenango, 3; Nenton, 1.

Honduras: Patuca, 2.
Oaxaca: Santo Domingo (mountains near), 2; Tuxtepec, 1.
Tamaulipas: Alta Mira, 1.
Vera Cruz: Jalapa, 24;[1] Jico, 2; Mirador, 1; Orizaba (type locality by fixation), 17; Pasa Nueva, 1;[2] Santiago Tuxtla, 1.

ORYZOMYS FULVESCENS LENIS GOLDMAN.

LOS REYES PYGMY RICE RAT.

(Pl. IV, figs. 6, 6a.)

Oryzomys fulvescens lenis Goldman, Proc. Biol. Soc. Washington, XXVIII, p. 130, June 29, 1915.

Type locality.—Los Reyes, Michoacan, Mexico.

Type.—No. 125941, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 14, 1903.

Geographic distribution.—Coastal plains and basal mountain slopes in Michoacan, Guerrero, and Oaxaca; altitudinal range from near sea level to about 3,000 feet, mainly in Arid Lower Tropical Zone.

General characters.—Similar to *O. f. fulvescens*, but upperparts paler ochraceous-buff, the general tone more yellowish; skull broader and more massive.

Color.—*Fresh pelage:* Upperparts between ochraceous-buff and light ochraceous-buff becoming warm buff on cheeks, shoulders, and lower part of sides; the face, top of head, and back sparingly lined with dark hairs; underparts, ears, feet, and tail as in *O. f. fulvescens.*

Skull.—Broader than that of *O. f. fulvescens;* zygomata more widely spreading; maxillary arms of zygomata and ascending branches of premaxillæ broader and heavier; dentition rather heavy, but equaled in some examples of *O. f. fulvescens.*

Measurements.—Type: Total length, 198; tail vertebræ, 115; hind foot, 23. Adult topotype: 188; 115; 23. Skull (type and adult topotype): Greatest length, 22.6, 21.8; zygomatic breadth, 12.3, 11.9; interorbital breadth, 3.4, 3.5; width of braincase, 10, 10.3; nasals, 8.6, 7.8; anterior palatine foramina, 3.9, 3.5; palatal bridge, 4.1, 3.7; upper molar series, 3, 3.

Remarks.—The general distribution area of *O. fulvescens* is divided north of the Isthmus of Tehuantepec by the high, interior plateau region, the western arm representing the range of *O. f. lenis.* Specimens from Guerrero and Oaxaca approach subspecies *fulvescens* in characters.

Specimens examined.—Total number, 4, as follows:

Guerrero: Ometepec (near), 1.
Michoacan: Los Reyes, 2 (type and topotypes).
Oaxaca: Pluma, 1.

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[1] Sixteen in Amer. Mus. Nat. Hist.; 2 in Mus. Comp. Zool.

[2] Collection Amer. Mus. Nat. Hist.

ORYZOMYS FULVESCENS MAYENSIS, SUBSP. NOV.

MAYA PYGMY RICE RAT.

Type locality.—Apazote (near Yohaltum), Campeche, Mexico (altitude 200 feet).

Type.—No. 107979, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 5, 1901. Original number 14405.

Geographic distribution.—Peninsula of Yucatan and Campeche; altitudinal range from near sea level to about 300 feet; Arid Lower Tropical Zone.

General characters.—Similar to *O. f. fulvescens*, but paler colored; skull slightly narrower.

Color.—*Fresh pelage:* Upperparts near ochraceous-buff shading toward light ochraceous-buff, darkest and rather sparingly lined with black over dorsum, becoming clearer and paler on cheeks, shoulders, and sides; underparts, ears, feet, and tail as in *O. f. fulvescens.*

Skull.—About like that of *O. f. fulvescens,* but zygomata and braincase slightly narrower.

Measurements.—Type: Total length, 177; tail vertebræ, 101, hind foot, 22. Average of three adult topotypes: 189 (184–196); 113 (108–119); 23 (22–24). *Skull* (average of three adults, type and two topotypes): Greatest length, 21.1 (20.4–21.8); zygomatic breadth, 11 (10.8–11.2); interorbital breadth, 3.6 (3.5–3.8); width of braincase, 9 (8.9–9.1); nasals, 8.1 (7.4–8.4); anterior palatine foramina, 3.3 (3.1–3.5); palatal bridge, 4 (3.6–4.4); upper molar series, 2.9 (2.9–3).

Remarks.—The pale color of this form seems to be due to the same environmental conditions that have been operative in the evolution of pallid races in other mammalian groups inhabiting Yucatan. In this region pale coloration is apparently associated with the arid climate and white limestone formation, outcropping or thinly overlaid with soil over large areas which have risen less than 300 feet above the level of the sea. At Chichen Itza the pygmy rice rat was taken in the vicinity of imposing Maya Indian ruins, a circumstance that suggested the subspecific name.

Specimens examined.—Total number, 7, as follows:

Campeche: Apazote, 4 (types and topotypes).
Yucatan: Chichen Itza, 1; Tunkas, 2.

ORYZOMYS FULVESCENS COSTARICENSIS ALLEN

COSTA RICAN PYGMY RICE RAT.

Oryzomys costaricensis Allen, Bull. Amer. Mus. Nat. Hist., V, p. 239, September 22, 1893.

Oryzomys (*Oligoryzomys*) *nicaraguæ* Allen, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 100, April 30, 1910. Type from Vijagua, Nicaragua, No. 29543, ♂ ad., Amer. Mus. Nat. Hist.; collected by W. B. Richardson, March 24, 1909.

Type locality.—El General, Costa Rica (altitude, 2,150 feet).

Type.—No. $\frac{2581}{7923}$, ♀ subadult, American Museum of Natural History, collected by H. Pittier, February, 1891.

Geographic distribution.—Southwestern Panama east to Canal Zone, Costa Rica, and north to northern Nicaragua; altitudinal range from near sea level to at least 2,000 feet.

General characters.—Similar to *O. f. fulvescens*, but upperparts usually more tawny; molars larger. Also similar to *O. f. vegetus*, but smaller and averaging paler.

Color.—About as in *O. f. fulvescens*, but upperparts usually more distinctly tawny.

Skull.—Closely resembling that of *O. f. fulvescens*, but molars larger, the toothrows decidedly longer. General size smaller than that of *O. f. vegetus*; molars about the same.

Measurements.—Two adults from Buenos Aires, Costa Rica: Total length, 183, 190; tail vertebræ, 100, 108; hind foot, 20, 23. *Skull* (same): Greatest length, 21.1, 21.5; zygomatic breadth, 11.4, 11.4; interorbital breadth, 3.7, 3.7; width of braincase, 9.9, 9.6; nasals, 8.2, 8; anterior palatine foramina, 3.6, 3.7; palatal bridge, 4, 4.2; upper molar series, 3.2, 3.2.

Remarks.—The general dimensions of *O. f. costaricensis* are about the same as those of *O. f. fulvescens*; the color difference is slight but the upperparts are usually more distinctly tawny. The most distinctive feature seems to be the larger molars and resulting elongation of the toothrows, a character shared with the larger and darker form *O. f. vegetus*. "*O. nicaraguæ*" was based on scanty material from Nicaragua which is not satisfactorily separable from *costaricensis*. The type, apparently full grown but with molars rather slightly worn, is not so tawny as most examples of *costaricensis*, but this color element is usually less distinct in younger individuals. The toothrows are long, as in *costaricensis*.

Specimens examined.—Total number, 19, as follows:

Costa Rica: Boruca, 7;[1] Buenos Aires, 2;[2] Cerro de Buena Vista, 1;[2] El General, 3 (type and topotypes);[2] La Carpintera, 1.[2]
Nicaragua: San Rafael del Norte, 1;[2] Vijagua, 1 (type of "*nicaraguæ*").[2]
Panama: La Chorrera, 1;[2] Old Panama, 2.[2]

ORYZOMYS FULVESCENS VEGETUS BANGS.

VOLCAN CHIRIQUI PYGMY RICE RAT.

Oryzomys (*Oligoryzomys*) *vegetus* Bangs, Bull. Mus. Comp. Zool., XXXIX, text fig. 15, p. 35, April, 1902.

Type locality.—Boquete, Volcan de Chiriqui, Panama (altitude, 4,000 feet).

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[1] Six in Amer. Mus. Nat. Hist.; 1 in Field Mus. Nat. Hist.

[2] Collection Amer. Mus. Nat. Hist.

Type.—No. 10298, ♀ old adult, Museum of Comparative Zoology (Bangs collection); collected by W. W. Brown, jr., April 16, 1901.

Geographic distribution.—Known only from the vicinity of type locality; Upper Tropical Zone.

General characters.—Size larger and color usually darker than in *O. f. costaricensis;* skull larger, but molar teeth relatively small.

Color.—About as in *O. f. fulvescens* and *O. f. costaricensis,* but general tone averaging darker than either, the tawny element in upperparts distinct as in *costaricensis;* abdomen varying in the darkest examples to a shade darker than light ochraceous-buff of Ridgway.

Skull.—Decidedly larger than that of *O. f. costaricensis,* with molar teeth actually about the same size, therefore relatively smaller.

Measurements.—Type: Total length, 210; tail vertebræ, 120; hind foot, 25. Average of six adult topotypes: 216 (205–235); 122 (115–130); 24.2 (24–25). *Skull* (average of 5 adults—type and 4 topotypes): Greatest length, 23.6 (22.7–24.3); zygomatic breadth, 12.3 (11.9–12.8); interorbital breadth, 3.8 (3.7–4.2); width of braincase, 10.3 (10–10.5); nasals, 8.7 (8.3–9.3); anterior palatine foramina, 3.6 (3.4–3.9); palatal bridge, 3.9 (3.8–4.3); upper molar series, 3.1 (3.1–3.1).

Remarks.—Larger average size and tendency toward darker coloration usually distinguish *O. f. vegetus* from the more northern forms of the group, but there seems to be no sharp line of demarcation between it and *O. f. costaricensis.* Both share the heavier dentition as compared with *O. f. fulvescens.* Four specimens in the topotype series were referred by Bangs to *costaricensis.* They are the paler examples and in color apparently do not differ from *costaricensis,* but the larger size of the skulls indicates that they belong with the remainder of the series of *vegetus.*

Specimens examined.—Twenty-two,[1] from type locality.

Subgenus **MELANOMYS** Thomas.

Melanomys Thomas, Ann. Mag. Nat. Hist., ser. 7, X, p. 248, Sept., 1902; Novitates Zool., X, no. 1, p. 41, Apr. 20, 1903 (subgenus). Type *Oryzomys phæopus* Thomas.

Melanomys Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 533, Nov. 17, 1913 (genus).

Geographic distribution.—Andean region of northwestern South America from southern Ecuador to northern Colombia, and northwestward through Panama and Costa Rica to northern Nicaragua; altitudinal range from near sea level to about 8,000 feet; mainly in Upper and Lower Tropical Zones.

Subgeneric characters.—Color very dark, upperparts and underparts not strongly contrasted; form robust; tail about three-fourths length of head and body, black all around; feet (epidermis and hair) blackish to base of claws, which are light horn color; hind feet broad, stout, the digital bristles not projecting beyond ends of claws.

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[1] Fifteen in Mus. Comp. Zool.; 7 in Field Mus. Nat. Hist.

Skull rotund; rostrum short, nearly straight; braincase large and inflated; frontals broad, the lateral margins projecting as supraorbital shelves; zygomata slender, but maxillary root decidedly expanded above along frontal and premaxillary sutures; antorbital foramen rather narrow above, but little compressed and opening widely below, the outer wall projecting slightly forward as viewed from above; lachrymal articulating mainly with maxilla; mastoid process of squamosal short and broad owing to slight excision of squamosal border. Molars slightly hypsodont; parastyle and protocone of first upper molar with oblique commissures; secondary parastyle rudimentary or fused with main element; incisors thin and weak, the upper ones descending about perpendicularly from premaxillæ, the points not decidedly curved backward.

Remarks.—This group of dark-colored forms, segregated by Thomas under the name *Melanomys* as a subgenus of *Oryzomys*, was elevated to generic rank by Allen in 1913. In general characters, and especially dentition, however, it approaches typical *Oryzomys* so closely that subgeneric recognition seems better to express the relationship. The most notable dental differences appear to be shown in the rather high molar crowns, comparatively straight, thin upper incisors, and the tendency toward suppression of the secondary parastyle normally present in typical *Oryzomys*. The secondary parastyle is normally fused with the parastyle, which is correspondingly enlarged. Among the more important cranial details are the expansion of the maxillary root of the zygoma over the antorbital foramen and the resulting alteration in the position of the lachrymal as compared with typical *Oryzomys*. The lachrymal in *Melanomys* articulates almost entirely with the maxilla, its position being anterior to the fronto-maxillary suture, while in typical *Oryzomys* it bridges this suture and about evenly overlaps the maxilla and frontal.

The subgenus *Melanomys* differs so strikingly from the subgenus *Oligoryzomys* in appearance that no close comparison is necessary, although most of the characters of the latter are found in varying combinations in the subgenus *Oryzomys*.

ORYZOMYS CALIGINOSUS (Tomes).

Hesperomys caliginosus Tomes, Proc. Zool. Soc. London, 1860, p. 263. Type from coast of Ecuador, probably Esmeraldas.[1] Type No. 7.1.1.128, British Museum; collected by Louis Fraser.

Akodon caliginosus Allen, Bull. Amer. Mus. Nat. Hist., XIV, p. 45, Jan. 31, 1901.

Hesperomys (*Melanomys*) *caliginosus* Thomas, Ann. Mag. Nat. Hist. ser. 8, XI, p. 406, Apr. 1913.

Melanomys caliginosus caliginosus [et al. subsp.] Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 537, Nov. 17, 1913.

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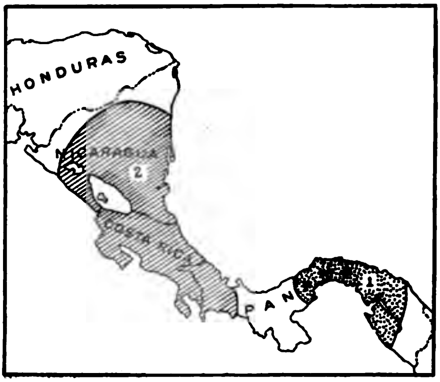
[1] See Allen (op. cit., pp. 533–554, 1913) for locality and revision of group regarded as generically distinct.

Geographic distribution.—(See under subgenus *Melanomys*) (fig. 11).

General characters.—(See subgeneric characters under subgenus *Melanomys.*)

Color.—*Fresh pelage:* Upperparts varying from tawny to russet, abundantly but finely mixed with black, the black tending to become predominant especially on rump; underparts overlaid with varying shades from dark ochraceous-tawny to cinnamon brown, the dark plumbeous basal color showing through; vibrissæ black, scarcely reaching posteriorly to ears; ears, feet, and tail thinly clothed with short hairs, the hairs and epidermis blackish. *Young* (in first pelage): Similar to adults, but upperparts usually more distinctly blackish, and underparts less heavily overlaid with ochraceous-tawny or cinnamon brown.



1. *O. c. idoneus.* | 2. *O. c. chrysomelas.*

FIG. 11.—Geographic distribution of subspecies of *Oryzomys caliginosus* (exclusive of South American forms).

Skull.—(See subgeneric characters under subgenus *Melanomys.*)

Remarks.—In a revision of the "*Melanomys*" group, Allen[1] assigns the component parts to several specific types on the basis of characters which seem comparatively unimportant; the slight departures exhibited either in color or cranial details, in examples from widely separated regions, point to the probable inclusion of most, if not all, of the forms in the species *O. caliginosus*. Two subspecies range within the limits of the region under review.

Key to Subspecies of O. caliginosus (Exclusive of South America).

a^1. Upperparts tending toward tawny; frontal region narrower. (Eastern Panama.) **O. c. idoneus** (p. 96).

a^2. Upperparts tending toward russet; frontal region broader. (Western Panama; Costa Rica; Nicaragua.)........................ **O. c. chrysomelas** (p. 97).

ORYZOMYS CALIGINOSUS IDONEUS GOLDMAN

CERRO AZUL DUSKY RICE RAT.

(Pl. IV, figs. 7, 7a; Pl. V, figs. 3, 12; Pl. VI, figs. 9, 9a.)

Oryzomys idoneus Goldman, Smiths. Misc. Coll., LVI, No. 36, p. 5, January 19, 1912.
Melanomys idoneus Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 548, November 17, 1913.

Type locality.—Cerro Azul, near headwaters of Chagres River, Panama (altitude, 2,500 feet).

Type.—No. 171106, ♀ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, March 26, 1911.

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[1] See Allen (op.cit., pp. 533–554, 1913) for locality and revision of group regarded as generically distinct.

Geographic distribution.—Heavily forested mountain slopes in eastern Panama; known altitudinal range from 1,800 to 2,800 feet; Humid Lower Tropical Zone.

General characters.—Similar to *O. c. caliginosus*, of Ecuador, but upperparts paler, more tawny, instead of russet in color. Closely resembling *O. c. chrysomelas*, but color paler; skull narrower between orbits.

Color.—*Fresh pelage:* Upperparts near tawny (becoming most intense in worn pelage), heavily and finely mixed with black, the mixture usually uniform, but black predominating on rump in some examples; underparts, including inner sides of limbs, dark ochraceous-tawny; inner sides of ankles black; ears, feet, and tail thinly clothed with short hairs, the hairs and epidermis blackish. *Young* (in first pelage): Upperparts usually more distinctly blackish than adults, the tawny element restricted to narrower tips of hairs.

Skull.—Similar to that of *O. c. caliginosus*, but frontal region narrower; molars slightly larger, the toothrows longer; anterior palatine foramina usually shorter. Closely resembling that of *O. c. chrysomelas*, but frontal region more constricted, the supraorbital borders less projecting laterally.

Measurements.—Type: Total length, 218; tail vertebræ, 88; hind foot, 30. Average of 10 adults from Cana, Panama: 217.9 (196–240); 93.3 (85–105); 26.7 (26–27.5). *Skull* (average of same): Greatest length, 30.1 (28.6–30.3); zygomatic breadth, 16.2 (15.1–16.7); interorbital breadth, 6.3 (5.9–6.5); width of braincase, 11.8 (11.2–12.3); nasals, 11.4 (10.7–12.6); anterior palatine foramina, 4.6 (4.4–5); palatal bridge, 6.1 (5.4–6.8); upper molar series, 4.7 (4.4–5).

Remarks.—While *O. c. idoneus* differs from typical *O. c. caliginosus* very appreciably in color, close relationship is evidenced in cranial characters, some skulls being scarcely distinguishable. In color it closely approaches *O. c. columbianus*, of the Santa Marta region of Colombia, but is slightly darker; the tail is usually shorter. In cranial characters similarity to *columbianus* is also shown, but the ascending branches of the premaxillæ are narrower posteriorly, the ends externally beveled in outline along the interdigitating frontopremaxillary line of contact.

Specimens examined.—Total number, 47, as follows:

Panama: Cana, 46; Cerro Azul, 1 (type).

ORYZOMYS CALIGINOSUS CHRYSOMELAS (ALLEN).

COSTA RICAN DUSKY RICE RAT.

(Pl. IV, figs. 8, 8a.)

Hesperomys (*Habrothrix*) *caliginosus* Allen, Bull. Amer. Mus. Nat. Hist., III, p. 210, Apr. 17, 1891 (Costa Rica).

Oryzomys chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., IX, p. 37, Mar. 11, 1897.

Oryzomys (*Melanomys*) *chrysomelas* Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 654, Oct. 13, 1908 (Nicaragua).

Zygodontomys chrysomelas Bangs, Bull. Mus. Comp. Zool., XXXIX, p. 37, April, 1902 (Panama).

Melanomys chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 547, Nov. 17, 1913.

Zogodontomys (*sic*) *chrysomelas* Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 547, Nov. 17, 1913.

Type locality.—Suerre, Costa Rica (altitude probably between 3,000 and 4,000 feet).

Type.—No. $\frac{10707}{9076}$, ♂ adult, American Museum of Natural History; collected by Anastasio Alfaro, July 16, 1895.

Geographic distribution.—Western Panama, Costa Rica, and north to northern Nicaragua; altitudinal range from near sea level to about 3,000 feet, mainly in Humid Lower Tropical Zone.

General characters.—Most closely allied to *O. c. idoneus*, but slightly darker in color; skull broader between orbits.

Color.—About as in *O. c. idoneus*, but rufescent element in upperparts darker and inclining toward the russet tone of the paler species of *O. c. caliginosus*.

Skull.—Similar to that of *O. c. idoneus*, but frontal region less constricted, the supraorbital borders more projecting laterally.

Measurements.—Average of five adults from Escondido River (45 miles from Bluefields), Nicaragua: Total length, 210 (202–217); tail vertebræ, 89 (87–90); hind foot, 25.9 (25–27). *Skull* (average of four adults from same locality): Greatest length, 29.1 (28.2–29.5); zygomatic breadth, 15.9 (15.8–16.1); interorbital breadth, 6.6 (6.3–6.8); width of braincase, 11.8 (11.4–12.2); nasals, 10.9 (10.1–11.5); anterior palatine foramina, 4.9 (4.8–5.1); palatal bridge, 5.6 (5.3–5.8); upper molar series, 4.5 (4.3–4.7).

Remarks.—The range of *O. c. chrysomelas* marks the northern limit of the species in Central America. The Costa Rican subspecies is most closely allied to its near geographic neighbor in eastern Panama, although in color the darker specimens approach some of the paler examples of *O. c. caliginosus* and other South American forms.

Specimens examined.—Total number, 61, as follows:

Costa Rica: Pacuare, 5; Port Limon, 1; San Carlos, 1;[1] Suerre, 5 (type and topotypes);[2] Talamanca (probably near Sipurio), 4.

Nicaragua: Chontales, 3;[1] Escondido River (45–50 miles from Bluefields), 14; Greytown, 1; Savala, 2;[1] Pena Blanca, 3;[1] Rio Coco, 3;[1] Rio Grande, 1;[1] Rio Tuma 5;[1] Tuma, 6:[1] Vijagua, 6.[1]

Panama: Mosca, 1.

PLATE I.

[All subgenus *Oryzomys*. Natural size; all in U. S. Nat. Mus., Biological Survey collection, except figs. 2, 2*a*.]

FIGS. 1, 1*a*. *Oryzomys palustris palustris* (Harlan). Georgetown, South Carolina. ♂ adult. (No. 71367.)

2, 2*a*. *Oryzomys palustris coloratus* Bangs. Type. Cape Sable, Florida. ♂ adult. (No. 4470, Mus. Comp. Zool.)

3, 3*a*. *Oryzomys couesi couesi* (Alston). Yaruca, Honduras. ♂ adult. (No. 131814.)

4, 4*a*. *Oryzomys couesi regillus* Goldman. Type. Los Reyes, Michoacan. ♂ adult. (No. 125945.)

5, 5*a*. *Oryzomys couesi aquaticus* Allen. Topotype. Brownsville, Texas. ♂ adult. (No. 65066.)

6, 6*a*. *Oryzomys gatunensis* Goldman. Type. Gatun, Canal Zone. ♂ young. (No. 171034.)

7, 7*a*. *Oryzomys cozumelæ* Merriam. Type. Cozumel Island, Mexico. ♂ adult. (No. 108462.)

8, 8*a*. *Oryzomys peninsulæ* Thomas. San Jose del Cabo, Lower California. ♀ adult. (No. 146618.)

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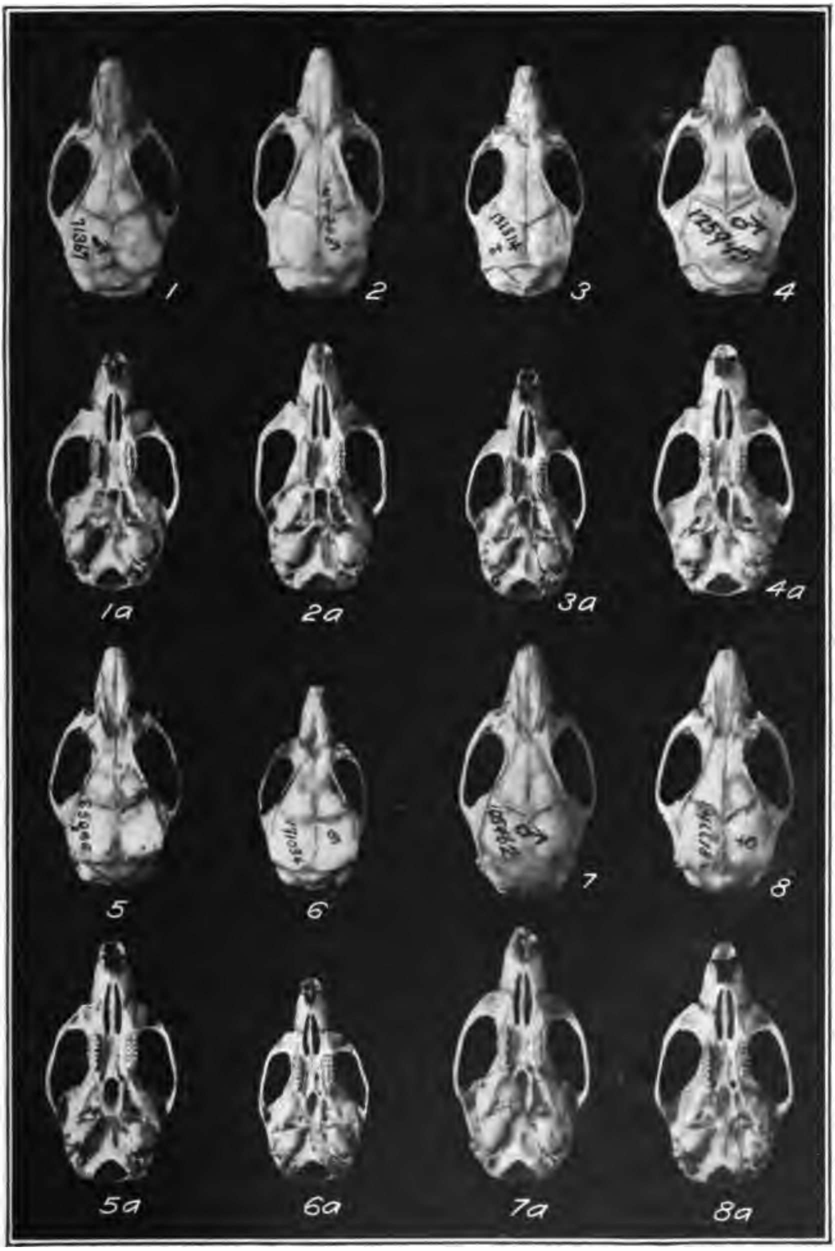
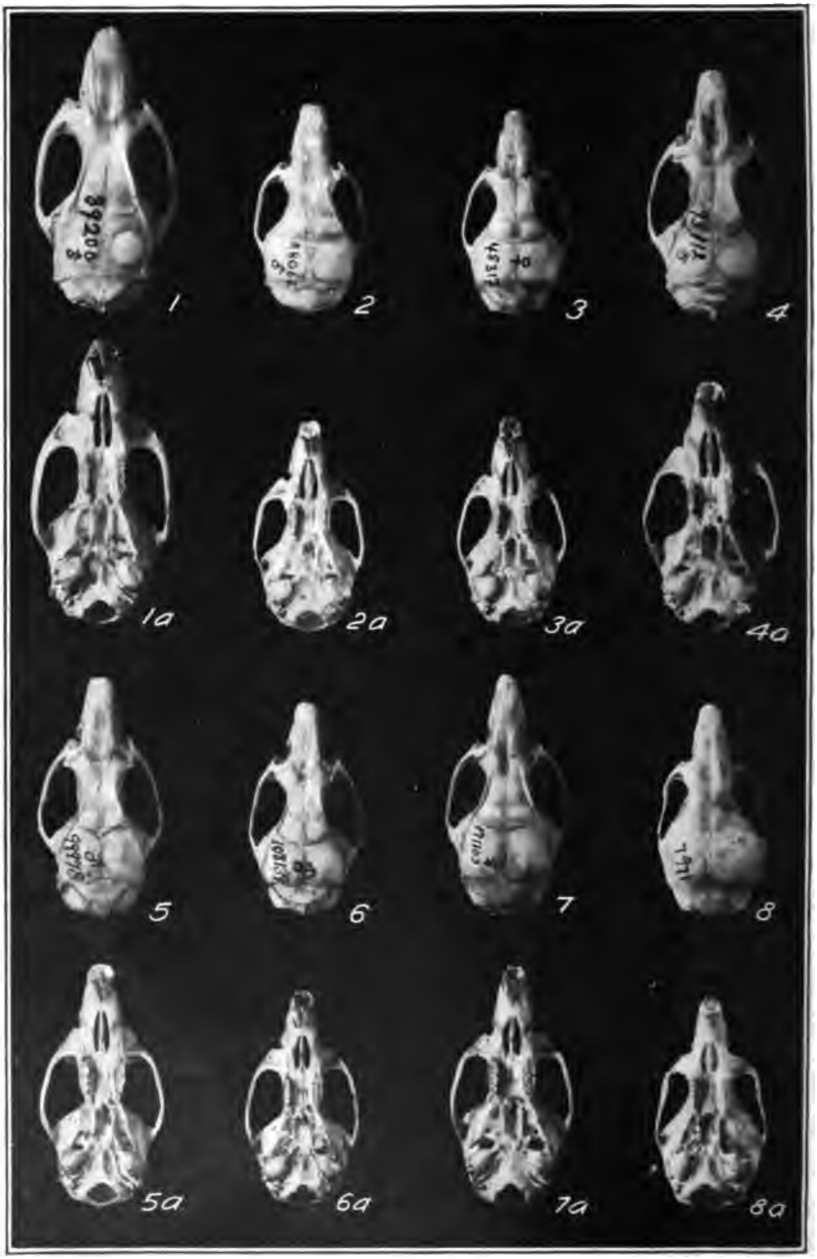
[1] Collection Amer. Mus. Nat. Hist.

[2] Four (including type) in Amer. Mus. Nat. Hist.; 1 in Field Mus. Nat. Hist.



SKULLS OF ORYZOMYS.

1, 1a. O. p. palustris.	5, 5a. O. c. aquaticus.
2, 2a. O. p. coloratus.	6, 6a. O. gatunensis.
3, 3a. O. c. couesi.	7, 7a. O. cozumelæ.
4, 4a. O. c. regillus.	8, 8a. O. peninsulæ.



SKULLS OF ORYZOMYS.

1, 1a. O. nelsoni.
2, 2a. O. m. melanotis.
3, 3a. O. m. colimensis.
4, 4a. O. r. rostratus.
5, 5a. O. r. megadon.
6, 6a. O. r. yucatanensis.
7, 7a. O. b. bombycinus.
8, 8a. O. b. alleni.

PLATE II.

[All subgenus *Oryzomys* Natural size; all in U. S. Nat. Mus., Biological Survey collection, except figs. 8, 8*a*.]

FIGS. 1, 1*a*. *Oryzomys nelsoni* Merriam. Type. Maria Madre Island, Mexico. ♂ adult. (No. 89200.)

2, 2*a*. *Oryzomys melanotis melanotis* Thomas. Topotype. San Sebastian, Jalisco. ♂ adult. (No. 88062.)

3, 3*a*. *Oryzomys melanotis colimensis*, subsp. nov. Type. Armeria, Colima. ♀ adult. (No. $\frac{33289}{46817}$.)

4, 4*a*. *Oryzomys rostratus rostratus* Merriam. Type. Metlatloyuca, Puebla. ♀ adult. (No. 93112.)

5, 5*a*. *Oryzomys rostratus megadon* Merriam. Type. Teapa, Tabasco. ♂ adult. (No. 99978.)

6, 6*a*. *Oryzomys rostratus yucatanensis* Merriam. Type. Chichen Itza, Yucatan. ♂ adult. (No. 108139.)

7, 7*a*. *Oryzomys bombycinus bombycinus* Goldman. Topotype. Cerro Azul, Panama. ♀ adult. (No. 171103.)

8, 8*a*. *Oryzomys bombycinus alleni* Goldman. Type. Tuis, Costa Rica. ♂ subadult. (No. $\frac{9881}{7871}$, Amer. Mus. Nat. Hist.)

PLATE III.

[All subgenus *Oryzomys*. Natural size; all in U. S. Nat. Mus., Biological Survey collection.

FIGS. 1, 1*a*. *Oryzomys alfaroi alfaroi* (Allen). Yaruca, Honduras. ♀ adult. (No. 131817.)

2, 2*a*. *Oryzomys alfaroi dariensis* Goldman. Type. Cana, Panama. ♀ adult. (No. 178660.)

3, 3*a*. *Oryzomys alfaroi rhabdops* Merriam. Type. Calel, Guatemala. ♂ adult. (No. 76813.)

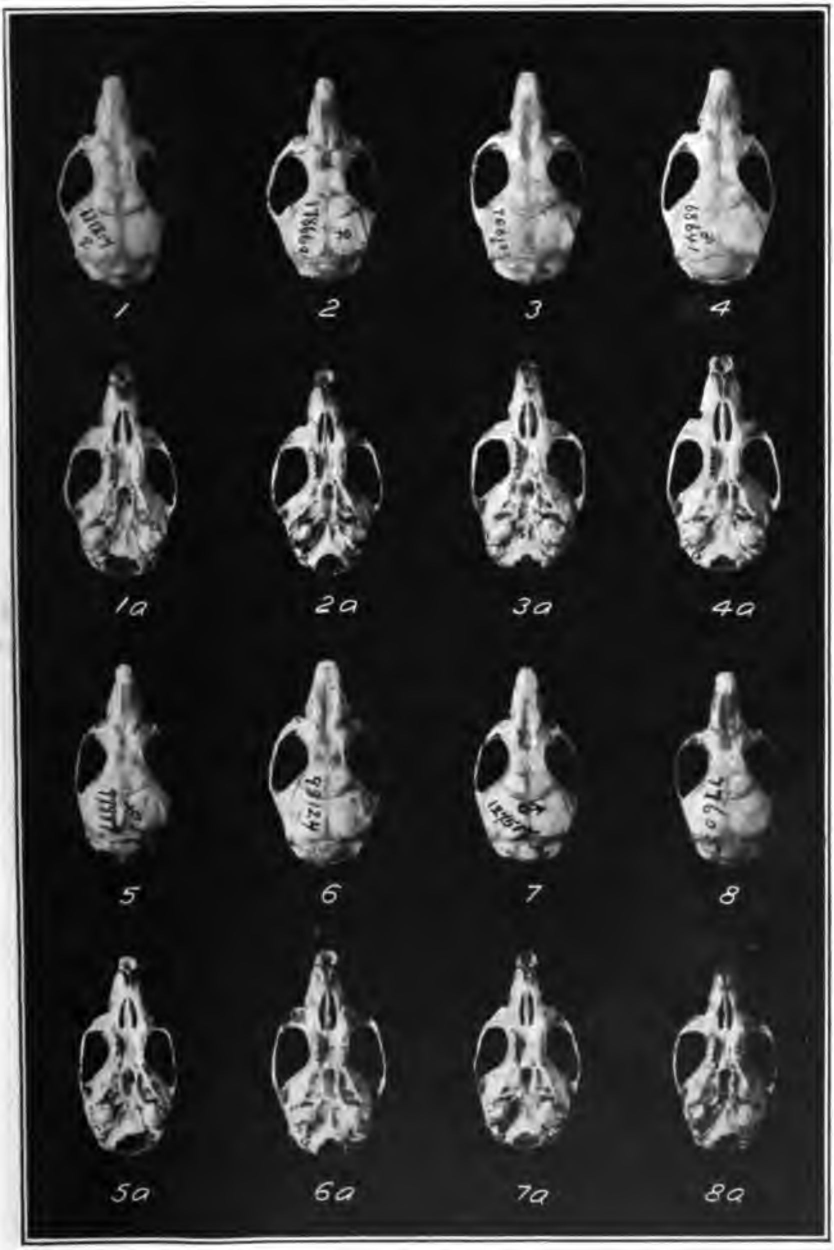
4, 4*a*. *Oryzomys alfaroi caudatus* Merriam. Type. Comaltepec, Oaxaca. ♂ adult. (No. 68641.)

5, 5*a*. *Oryzomys alfaroi palatinus* Merriam. Type. Teapa, Tabasco. ♀ adult. (No. 99977.)

6, 6*a*. *Oryzomys alfaroi dilutior* Merriam. Type. Huauchinango, Puebla. ♂ adult. (No. 93124.)

7, 7*a*. *Oryzomys guerrerensis* Goldman. Type. Omilteme, Guerrero. ♂ adult. (No. 127517.)

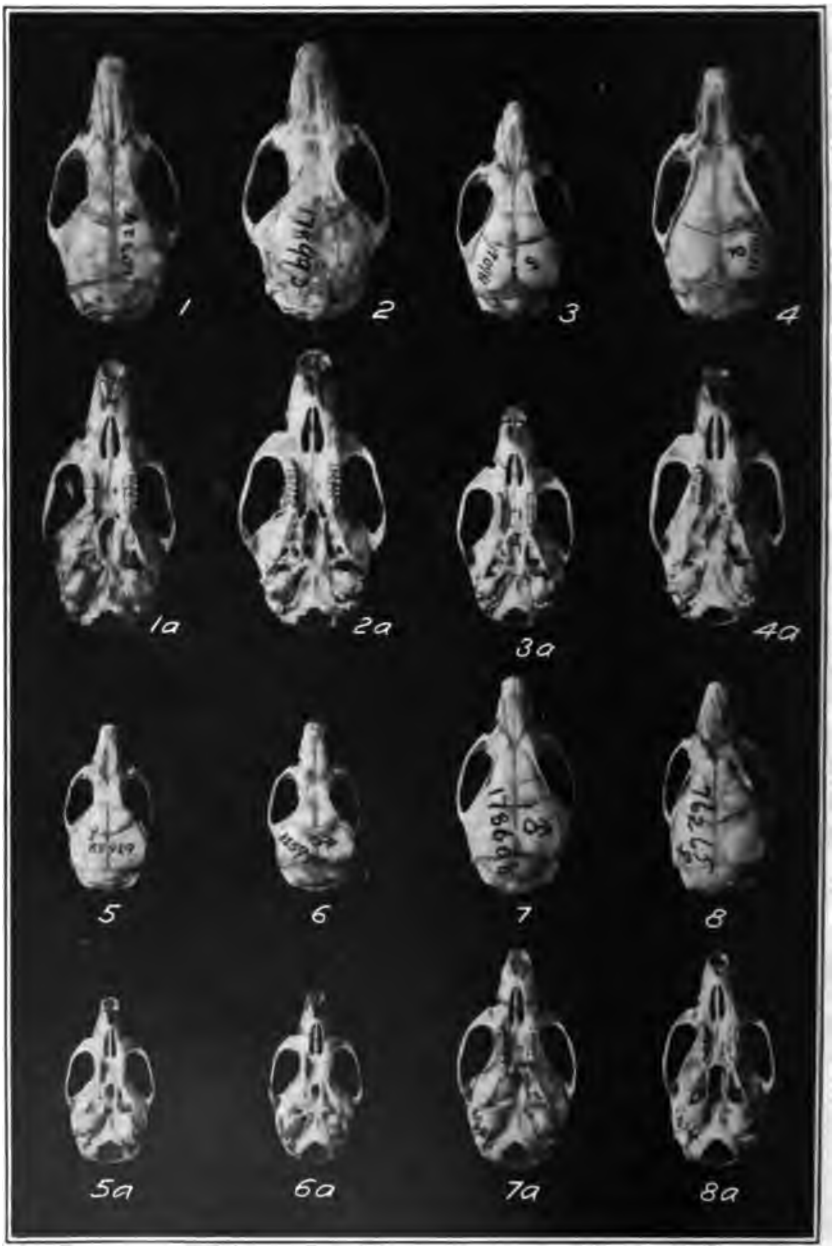
8, 8*a*. *Oryzomys hylocetes* Merriam. Type. Chicharras, Chiapas. ♂ adult. (No. 77605.)



SKULLS OF ORYZOMYS.

1, 1a. O. a. alfaroi.
2, 2a. O. a. dariensis.
3, 3a. O. a. rhabdops.
4, 4a. O. a. caudatus.
5, 5a. O. a. palatinus.
6, 6a. O. a. dilutior.
7, 7a. O. guerrerensis.
8, 8a. O. hylocetes.

PLATE IV.



SKULLS OF ORYZOMYS.

1, 1a. O. devius.
2, 2a. O. pirrensis.
3, 3a. O. talamancæ.
4, 4a. O. t. frontalis.
5, 5a. O. f. fulvescens.
6, 6a. O. f. lenis.
7, 7a. O. c. idoneus.
8, 8a. O. c. chrysomelas.

PLATE IV.

[Natural size; all in U. S. Nat Mus., Biological Survey collection, except figs. 1, 1a.]

FIGS. 1, 1*a*. *Oryzomys* (*Oryzomys*) *devius* Bangs. Type. Boquete, Panama. ♀ adult. (No. 10324, Mus. Comp. Zool.)

2, 2*a*. *Oryzomys* (*Oryzomys*) *pirrensis* Goldman. Type. Mount Pirre, Panama. ♂ adult. (No. 178993.)

3, 3*a*. *Oryzomys* (*Oryzomys*) *talamancæ* Allen. Gatun, Canal Zone. ♂ adult. (No. 170981.)

4, 4*a*. *Oryzomys* (*Oryzomys*) *tectus frontalis* Goldman. Type. Corozal, Canal Zone. ♀ adult. (No. 171531.)

5, 5*a*. *Oryzomys* (*Oligoryzomys*) *fulvescens fulvescens* (Saussure). Orizaba, Vera Cruz. ♂ adult. (No. 63688.)

6, 6*a*. *Oryzomys* (*Oligoryzomys*) *fulvescens lenis* Goldman. Type. Los Reyes, Michoacan. (No. 125941.)

7, 7*a*. *Oryzomys* (*Oligoryzomys*) *caliginosus idoneus* Goldman. Cana, Panama. ♂ adult. (No. 178608.)

8, 8*a*. *Oryzomys* (*Oligoryzomys*) *caliginosus chrysomelas* (Allen). Port Limon, Costa Rica. ♂ adult. (No. 76265.)

PLATE V.

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIG. 1. *Oryzomys* (*Oryzomys*) *palustris palustris* (Harlan). Georgetown, South Carolina. ♂ adult. (No. 71367.)

2. *Oryzomys* (*Oligoryzomys*) *fulvescens fulvescens* (Saussure). Orizaba, Vera Cruz. ♂ adult. (No. 58248.)

3. *Oryzomys* (*Melanomys*) *caliginosus idoneus* Goldman. Cana, Panama. ♂ adult. (No. 178663.)

4. *Oryzomys* (*Oryzomys*) *palustris palustris* (Harlan). Greenwich, New Jersey. ♂ adult. (No. 117384.)

5. *Oryzomys* (*Oryzomys*) *melanotis melanotis* Thomas. San Sebastian, Jalisco. ♂ adult. (No. 88061.)

6. *Oryzomys* (*Oryzomys*) *alfaroi dariensis* Goldman. Cana, Panama. ♂ adult. (No. 178657.)

7. *Oryzomys* (*Oryzomys*) *talamancæ* Allen. Gatun, Canal Zone. ♀ adult. (No. 170979.)

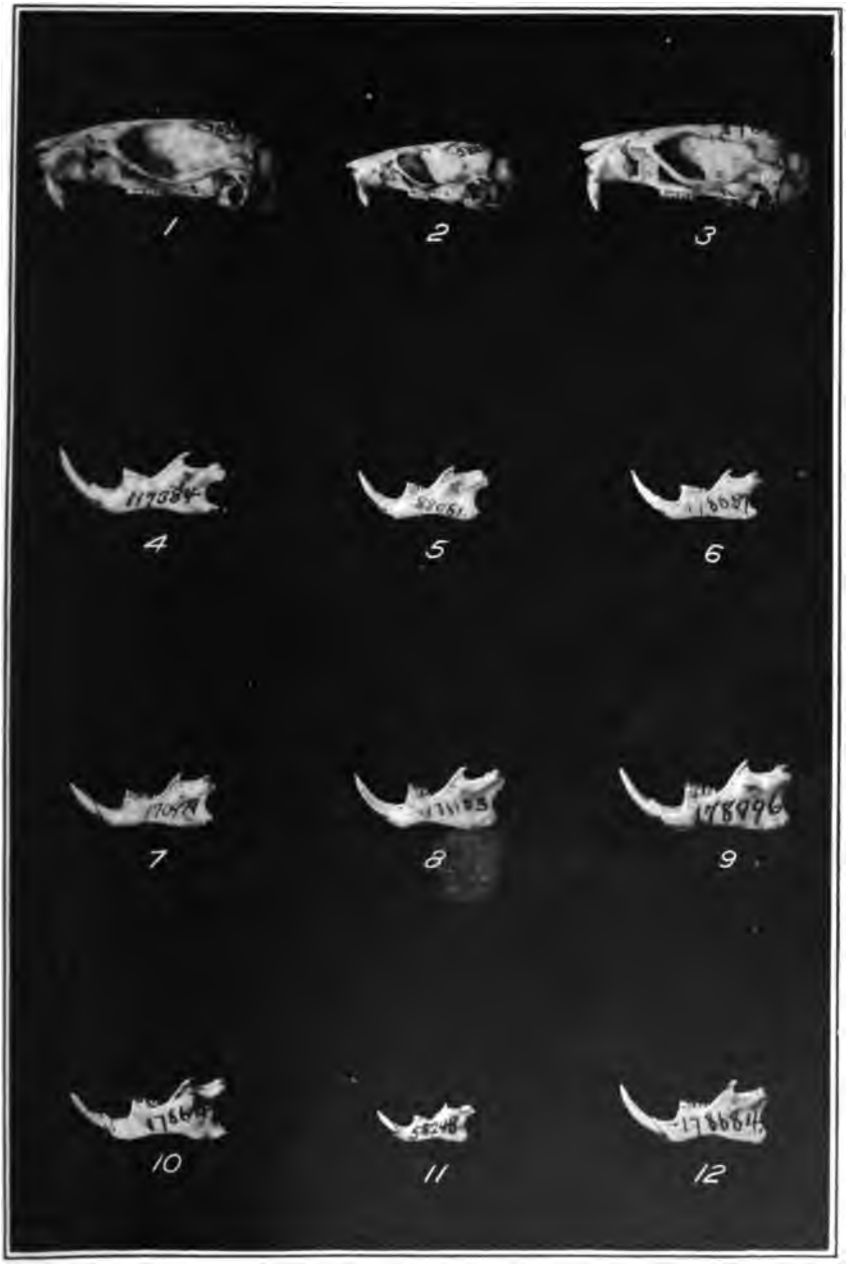
8. *Oryzomys* (*Oryzomys*) *bombycinus bombycinus* Goldman. Cerro Azul, Panama ♀ adult. (No. 171103.)

9. *Oryzomys* (*Oryzomys*) *pirrensis* Goldman. Mount Pirre, Panama. ♂ adult. (No. 178996.)

10. *Oryzomys* (*Oryzomys*) *tectus frontalis* Goldman. Cana, Panama. ♂ adult. (No. 178649.)

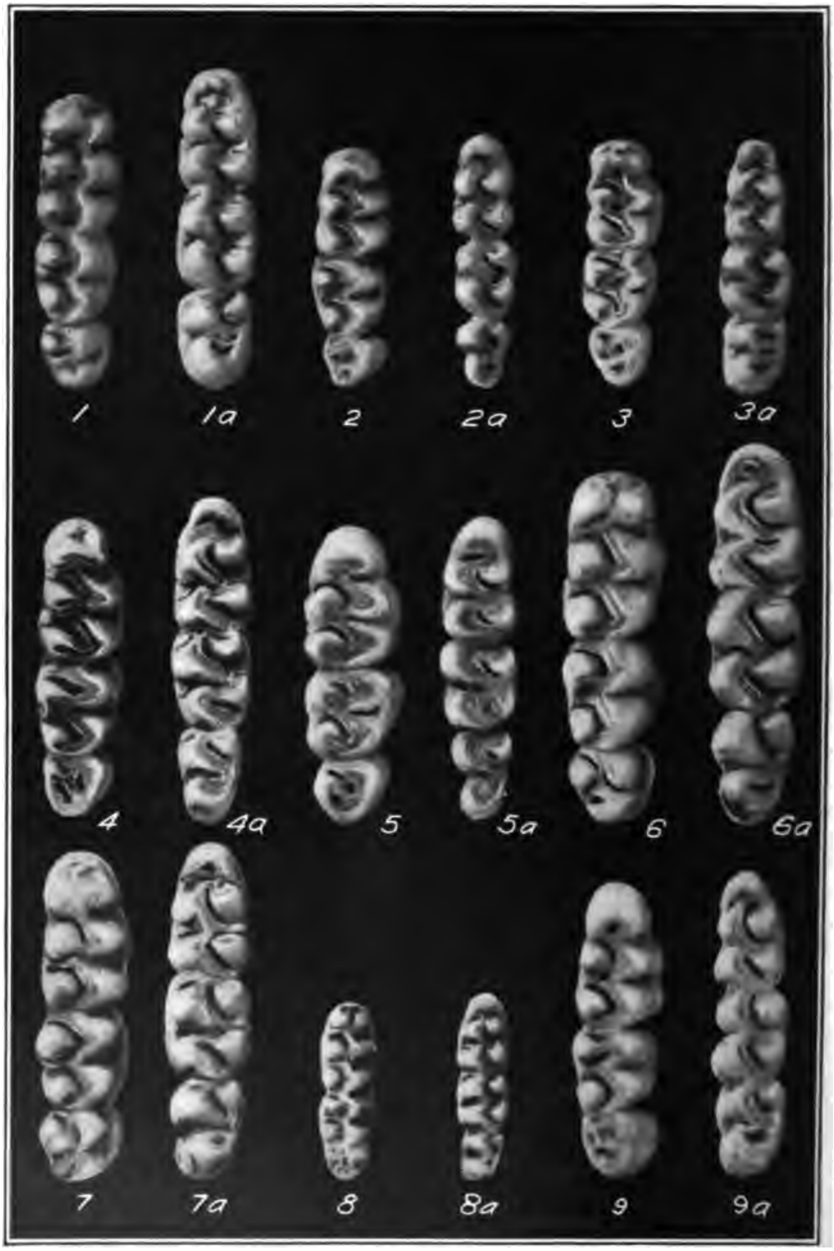
11. *Oryzomys* (*Oligoryzomys*) *fulvescens fulvescens* (Saussure). Orizaba, Vera Cruz. ♂ adult. (No. 58248.)

12. *Oryzomys* (*Melanomys*) *caliginosus idoneus* Goldman. Cana, Panama. ♂ adult. (No. 178684.)



SKULLS AND MANDIBLES OF ORYZOMYS.

1, 4. O. p. palustris.
2, 11. O. f. fulvescens.
3, 12. O. c. idoneus.
5. O. m. melanotis.
6. O. a. dariensis.
7. O. talamancæ.
8. O. b. bombycinus.
9. O. pirrensis.
10. O. t. frontalis.



MOLARS OF ORYZOMYS.

1, 1a. O. p. palustris.
2, 2a. O. m. melanotis.
3, 3a. O. a. dariensis.
4, 4a. O. talamancæ.
5, 5a. O. b. bombycinus.
6, 6a. O. pirrensis.
7, 7a. O. t. frontalis.
8, 8a. O. f. fulvescens.
9, 9a. O. c. idoneus.

PLATE VI.

Slightly retouched and enlarged about eight diameters; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Oryzomys* (*Oryzomys*) *palustris palustris* (Harlan). Dismal Swamp, Virginia. ♂ subadult. (No. 75203.)

2, 2*a*. *Oryzomys* (*Oryzomys*) *melanotis melanotis* Thomas. Ixtapa, Jalisco. ♂ subadult. (No. 88068.)

3, 3*a*. *Oryzomys* (*Oryzomys*) *alfaroi dariensis* Goldman. Cana, Panama. ♂ subadult. (No. 178653.)

4, 4*a*. *Oryzomys* (*Oryzomys*) *talamancæ* Allen. Cana, Panama. ♀ subadult. (No. 179601.)

5, 5*a*. *Oryzomys* (*Oryzomys*) *bombycinus bombycinus* Goldman. Cerro Azul, Panama. ♀ adult. (No. 171103.)

6, 6*a*. *Oryzomys* (*Oryzomys*) *pirrensis* Goldman. Mount Pirre, Panama. ♀ subadult. (No. 179030.)

7, 7*a*. *Oryzomys* (*Oryzomys*) *tectus frontalis* Goldman. Cana, Panama. ♀ subadult. (No. 178646.)

8, 8*a*. *Oryzomys* (*Oligoryzomys*) *fulvescens fulvescens* (Saussure). Orizaba, Vera Cruz. ♂ subadult. (No. 58244.)

9, 9*a*. *Oryzomys* (*Melanomys*) *caliginosus idoneus* Goldman. Cana, Panama. ♀ subadult. (No. 178668.)

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[New names in **bold-faced type**; synonyms in *italics;* principal references in **bold-faced figures.**]

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BUREAU OF BIOLOGICAL SURVEY
E. W. NELSON, *Chief*

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No. 44

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REVISION OF THE AMERICAN FLYING SQUIRRELS

BY

ARTHUR H. HOWELL
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., March 9, 1917.

SIR: I have the honor to transmit for publication as North American Fauna No. 44 a revision of the American flying squirrels (genus *Glaucomys*), by Arthur H. Howell, assistant biologist of this bureau. The revision is based largely upon material in the collection of the Biological Survey. Flying squirrels are found over much of North America, and this report on the group gives needed information concerning the number of forms and their distribution.

Respectfully,

E. W. NELSON,
Chief Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

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No. 44. NORTH AMERICAN FAUNA. June 13, 1918.

REVISION OF THE AMERICAN FLYING SQUIRRELS.

By ARTHUR H. HOWELL.

INTRODUCTION.

The American flying squirrels comprise two distinct groups—the small species (*Glaucomys volans*) of eastern United States and Mexico; and the larger species (*G. sabrinus*) occupying western United States and Canada, with one form ranging into New England and the border States along the Great Lakes (fig. 1).

HABITS.

Flying squirrels are almost exclusively arboreal, seldom descending to the ground and apparently never running for any distance on its surface. They are unsuspicious and, being easily tamed, make very attractive pets.[1] Possessed of intense activity, their movements are the acme of grace and agility. They do not fly, in the usual sense of the term, but progress from tree to tree by gliding with outstretched membranes from an elevated position to a point lower down, usually near the ground. Just before alighting, the animal checks its momentum by sweeping upward in a gentle curve and alights on the tree trunk with its head up. Ascending the tree by climbing, it is ready for another flight. In these gliding leaps, which may extend for a distance of 50 yards or more, the squirrel is able to change its course to one side or the other with perfect ease.

Unlike all other American squirrels, the flying squirrels are strictly nocturnal. During the daytime they remain concealed in their nests and are never seen abroad unless frightened from their retreats. Usually they may be driven readily from their holes by pounding with an ax or club on the base of the tree in which they are sleeping. Woodchoppers frequently scare them out when felling timber, and anyone who camps frequently in the woods is likely to hear them at night running or jumping about in the trees or dropping nuts to the ground.

---

[1] A pair of flying squirrels regularly visit the sixth floor of an apartment house fronting the National Zoological Park, Washington, D. C., and although usually averse to the glare of an electric light, they will when hungry eat nuts in apparent unconcern within 5 or 6 feet of an observer. They run up and down the stuccoed sides of the building with perfect ease, doubtless reaching the middle stories by jumping from a near-by tree. Their visits usually are between dark and midnight.

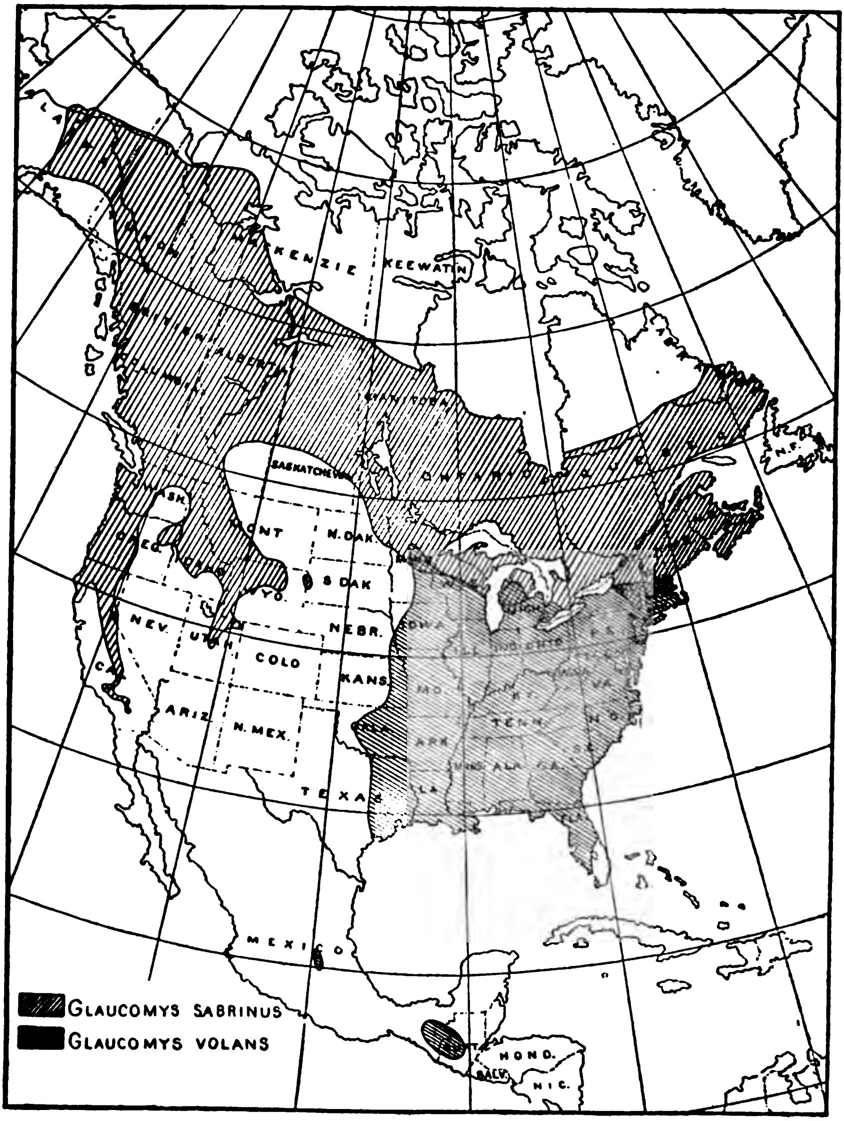

Fig. 1.—Map showing the distribution of *Glaucomys sabrinus* and *G. volans*, based on specimens examined and reports of occurrence.

VOICE.

The notes of *Glaucomys volans* are described by Vernon Bailey as a "fine, whistling squeak," and Wood says of the same species: "The flying squirrel has three quite diverse calls or cries. It utters the usual 'chuck-chuck' of squirrels, the usual quick, sharp squeak when scolding, and also, more rarely, a clear musical note, commonly melodious and pleasant, but occasionally shrill. This resembles the chirp of a bird and may be kept up for ten minutes at a time."[1] Seton, writing of the northern flying squirrel, *G. sabrinus*, in Manitoba, says: "The cry of this species is said to be like that of *volans*, which is a prolonged squeak not unlike the complaint of a red-eyed vireo whose nest is threatened."[2]

NESTS.

These squirrels are found only in wooded regions, and for homes they depend chiefly on hollow trees or stubs and deserted woodpecker nests. They often take up their abode, also, in attics, in outbuildings, or in boxes constructed for martins or other birds. Audubon and Bachman mention finding a number of flying squirrels in crevices of rock at Red Sulphur Springs, Va. In the cavity chosen for a home a nest is constructed of shreds of bark, dry leaves, moss, feathers, fur, or other soft material. Outside nests are often built, or the deserted nests of birds or of other squirrels utilized. Concerning this habit (in *Glaucomys volans*) Mearns says:

> Not infrequently it builds outside nests, and even lives in them during the winter. Some resemble the leaf nests of the gray squirrel externally, though there is always a warm lining within; other nests are indistinguishable from those of red squirrels; and others still are deftly woven of the softest possible materials.[3]

Helme,[4] writing from Long Island, N. Y., and Rhoads,[5] writing from Pennsylvania, both mention this habit in *volans*, and both state that an evergreen tree usually is selected as a site for the nest. Evermann and Clark[6] speak of finding in Indiana a large globular nest of fibrous material situated in the crotch of a small oak; and King[7] describes a summer nest built of small twigs and oak leaves, and lined with grass, situated about 10 feet from the ground in a small oak.

The larger squirrels of the *sabrinus* group also occasionally construct outside nests, although, as is the case with *volans*, hollow trees usually are preferred. J. Ellis McLellan, at Gold Beach, Oreg., once found a flying squirrel occupying a small spherical nest made of sticks and moss placed in a small fir tree. Vernon Bailey, at McKenzie Bridge, Oreg., found soft nests of the flying squirrel in the masses of tree moss (*Hypnum*) which cover the trunks and branches of maple and ash trees in the deepest forest. There were runways up the trunks under the mossy fleece and others where the moss had been worn away by constant use. At Elk River, Minn., in November, 1904, Charles Bailey found two of the large flying squirrels (*G. sabrinus macrotis*) occupying a nest of sticks and moss in a small tamarack. At Florence, Mont., on June 11, 1910, Clarence Birdseye found in a pile of cordwood a flying squirrel's nest containing 4 young with eyes not yet open.

---

[1] Wood, F. E., Bull. Illinois State Lab. Nat. Hist., VIII, pp. 535–536, 1910.
[2] Seton, E. T., Life Hist. Northern Anim., I, p. 441, 1909.
[3] Mearns, E. A., Bull. Amer. Mus. Nat. Hist., X, p. 342, 1898.
[4] Helme, A. H., Abstr. Proc. Linn. Soc. New York, Nos. 13–14, p. 23, 1902.
[5] Rhoads, S. N., Proc. Acad. Nat. Sci. Philadelphia, p. 389, 1894.
[6] Proc. Washington Acad. Sci., XIII, p. 15, 1911.
[7] King, F. H., Amer. Nat., XVII, p. 36, 1883.

Flying squirrels apparently do not hibernate, but are known to lay up stores of food and to remain for a large part of the winter within their nests. During the winter and to some extent, also, at other seasons they are somewhat gregarious in habit. At Mullan, Idaho, in June, Clark P. Streator started 8 adults (*G. s. latipes*) from a hollow tree and secured 6 of them, all of which proved to be males. Seton mentions finding 9 adults (*G. s. canescens*) in a hollow stub at Carberry, Manitoba.[1] The same habit is possessed by *G. volans;* Prof. U. O. Cox, of Farmland, Ind., found, in November, 15 of these squirrels in a small rotten stub a little higher than a man's head,[2] and at Dothan, Ala., in March, the writer started 6 from a similar stub in a wooded swamp. Audubon and Bachman record finding 20 in a martin box having 8 or 10 apartments, placed on top of a large locust tree, the box being occupied, also, by bats and screech owls.[3] Dr. J. Schneck states that he once ran as many as 50 out of one den.[4] Audubon and Bachman narrate an interesting experience with flying squirrels near Philadelphia, Pa., where not less than 200 were observed at once about sunset engaged in sportive gambols in a grove of trees.[5]

BREEDING.

The number of young produced at a birth varies from 3 to 6—usually 4 or 5. The period of gestation is said to be one month,[6] but no definite evidence on this point is available. In the Northern States the young of *Glaucomys volans* are brought forth in April, and a second brood may be produced in August or September. Evermann and Clark[7] describe finding small naked young ones in Indiana on August 19, and Langdon[8] records young with eyes not yet open at Madisonville, Ohio, September 7.

---

[1] Seton, E. T., Life Hist. Northern Anim., I, p. 441, 1909.

[2] Evermann and Clark, Proc. Washington Acad. Sci., XIII, p. 16, 1911.

[3] Audubon and Bachman, Quadr. North Amer., I, p. 220, 1846.

[4] Wood, F. E., Bull. Illinois State Lab. Nat. Hist., VIII, p. 534, 1910.

[5] Audubon and Bachman, Quadr. North Amer., I, p. 218, 1846.

[6] D. W. C., On the Habits of the American Flying Squirrels (*Pteromys volucella* Cuv.): Mag. Nat. Hist., IX, pp. 569–572, 1836.

[7] Evermann and Clark, Proc. Washington Acad. Sci., XIII, p. 15, 1911.

[8] Langdon, Frank W., Journ. Cincinnati Soc. Nat. Hist., III, p. 308, 1881.

The large flying squirrels of the *sabrinus* group apparently breed somewhat later than *volans*. Seton records a specimen taken at Winnipeg, Manitoba, on April 21, which contained 6 young ready for birth; and a nest of 4 young, with eyes not opened, found May 15[1]. Merriam found nursing young of *G. s. macrotis* about a month old in northern New York on June 18. In the Bitterroot Mountains, Mont., at 4,500 feet altitude, Clarence Birdseye took a female of *G. s. bangsi*, May 17, 1910, containing two large embryos; and in the Bitterroot Valley, near Florence, Mont., found a nest of small nursing young on June 11.

FOOD.

The food of flying squirrels consists in large part of nuts, including, probably, most of the native species—chestnuts, acorns, beechnuts, hickory nuts, pecans, and others. Catesby includes pine seeds and persimmon berries in their diet, and Prof. D. E. Lantz states that they frequently gather and store seeds of the cultivated cherry. Stomachs of three specimens of *volans* taken in Virginia in January contained finely chewed chestnut meats, a few pieces of acorn, and several beetle larvæ—probably secured with the nuts. Several stomachs taken at Red Fork, Okla., in June contained only remains of insect larvæ. Buds of trees are said to be eaten in winter, and corn or other grain sometimes is taken. Beetles and perhaps other insects constitute a part of the animals' fare. They have a decided taste for meat, and are so frequently caught by fur trappers in meat-baited traps set for larger game as to constitute a nuisance. Rowley states that he has known the small eastern species (*volans*) to gnaw the edges of meat hung from the rafters of an outhouse.[2] Flying squirrels are suspected by some observers of destroying the eggs of wild birds, and Merriam remarks that the eagerness with which these animals seize and feast upon a dead bird placed within their reach would indicate that they are not strangers to such a repast.[3] King states that in confinement they eat birds' eggs with great satisfaction, and relates an instance of the instant killing by them of a nestling chipping sparrow placed in their cage. A large moth introduced alive was also quickly captured and eaten.[4]

A writer in "Forest and Stream," describing the habits of flying squirrels in captivity, states that they were fond of parsley, pansy flowers, and apple-tree twigs, the last being devoured with great avidity, the leaves and bark stripped clean from the wood. This writer states also that the squirrels were fond of moths and grasshoppers, but refused crickets, and their preference in nuts was for acorns, filberts, and pecans.[1]

---

[1] Seton, E. T., Life Hist. Northern Anim., p. 442, 1909.

[2] Rowley, J., Abstr. Proc. Linn. Soc. New York, Nos. 13–14, p. 40, 1902.

[3] Merriam, C. Hart., Trans. Linn. Soc. New York, II, p. 100, 1884.

[4] King, F. H., Amer. Nat., XVII, pp. 40–41, 1883.

Stores of food laid up by flying squirrels for winter use have occasionally been found, indicating that the hoarding habit is probably general. Audubon and Bachman record an instance of a martin box occupied by a considerable number of flying squirrels, in which was found a quantity of hickory nuts, chestnuts, acorns, and corn.[2]

ECONOMIC STATUS.

The food habits of the flying squirrels are such that they are almost entirely harmless. So far as known they do not damage farm crops, and the relatively small number of nuts which they consume does not seriously affect the total supply. They have been suspected of destroying the eggs and young of wild birds, but no definite evidence on this point is forthcoming. Occasionally they may take possession of bird boxes or enter the lofts of dwelling houses and thus become objectionable, but ordinarily their gentle and confiding ways and their interesting habits make them desirable neighbors.

PELAGE AND MOLT.

The pelage in members of this genus is of moderate length, very dense, fine, and silky in texture. Apparently only one complete molt occurs in a year, in the autumn, from September to November. The new pelage usually appears first on the sides and spreads thence over the back, the head and shoulders being the last parts to be renewed. The effects of wear usually are not noticeable until March, but from then till November many worn specimens are to be found, though apparently a considerable proportion retain the winter pelage throughout the summer with little indication of wear. The head, nape, and rump are first subject to wear, though frequently the entire upperparts and tail become much worn. In summer there is a general tendency to a reddening of the hairs on the upperparts.

In *Glaucomys volans* and in most, if not all, of the races of *G. sabrinus* the middle portion of the soles in summer is naked, the same portions being furred in winter pelage in all forms except the southern races of *volans*. In one race (*G. volans volans*) the hind toes are conspicuously marked with white in winter, but are brown in summer. The exact manner of this change is not apparent, but it probably is accomplished by a partial spring molt.[3]

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[1] "C. C. H.," Forest and Stream, LII, pp. 125–126, 1899.

[2] Audubon and Bachman, Quad. North Amer., I, p. 220, 1846.

[3] For a detailed account of the molt in *G. volans* see, under that species, pp. 20–22.

EXPLANATION OF CRANIAL MEASUREMENTS.

The following measurements of skulls of this genus have been taken in millimeters:

Greatest length.—From anterior border of nasals to posterior border of supraoccipital in median line.

Zygomatic breadth.—Greatest breadth across zygomata.

Mastoidal breadth.—Greatest breadth across mastoids.

Interorbital breadth.—Shortest distance across frontals in front of postorbital processes.

Postorbital breadth.—Shortest distance across frontals behind postorbital processes.

Length of nasals.—Greatest length of nasals, measured along median line.

Maxillary toothrow.—Alveolar length of maxillary molar-premolar toothrow.

MATERIAL EXAMINED.

For the present revision the writer has assembled for study 1,052 specimens. About half of these are contained in the United States National Museum, including the Biological Survey and Merriam collections. The remainder have been borrowed from other American museums and from private collections, so that practically all the available material in this country has been at the disposal of the reviser.[1]

Genus GLAUCOMYS Thomas.

Mus Linnæus, Syst. Nat., Ed. 10, p. 63 (part), 1758.
Sciurus Pallas, Nov. Spec. Glires, p. 350 (part), 1778. Not *Sciurus* Linnæus, 1758.
Pteromys Tiedemann, Zool., I, p. 451 (part), 1808. Not *Pteromys* G. Cuvier, 1800.
Sciuropterus Lesson, Manuel de Mamm., p. 242, 1827 (part); Desmarest, Dict. Sci. Nat., p. 140, 1827 (part). Not *Sciuropterus*, F. Cuvier, 1825.
Glaucomys Thomas, Ann. and Mag. Nat. Hist. (ser. 8), I, p. 5, 1908. Type, *Mus volans* Linnæus.

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[1] For the loan of this material the writer desires to extend thanks to the owners and custodians as follows: Dr. J. A. Allen, of the American Museum of Natural History; Messrs. Samuel Henshaw and Outram Bangs, of the Museum of Comparative Zoology; Dr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia; Messrs. Charles B. Cory and W. H. Osgood, of the Field Museum of Natural History; Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology, University of California; Mr. P. A. Taverner, of the Victoria Memorial Museum; Mr. F. Kermode, of the Provincial Museum, Victoria, British Columbia; Dr. W. J. Holland and Mr. W. E. Clyde Todd, of the Carnegie Museum; Dr. A. G. Ruthven, of the University of Michigan; Mr. C. D. Bunker, of the Kansas University Museum; Mr. Myron H. Swenk, of the University of Nebraska; Mr. J. D. Figgins, of the Colorado Museum of Natural History; Mr. J. O. Snyder, of Leland Stanford, Jr., University; Dr. Barton W. Evermann, of the California Academy of Sciences; Mr. Henry L. Ward, of the Milwaukee Public Museum; Mr. W. E. Saunders, of London, Ontario; Mr. Edward R. Warren, of Colorado Springs, Colo.; Mr. G. L. Kirk, of Rutland, Vt., and Dr. H. V. Ogden, of Milwaukee, Wis.; and to Mr. Francis Harper for the photograph from which the frontispiece was made.

HISTORY AND NOMENCLATURE.

The small eastern flying squirrel (*Glaucomys volans*), which is very common in Virginia and the other South Atlantic States, attracted the notice of the earliest colonists and through their descriptions early became known to naturalists. Captain John Smith, in his History of Virginia, published originally in 1624, refers to the animal in the following words:

> A Small beast they have they call Assapanick, but we call them flying Squirrels, because spreading their legs, and so stretching the largenesse of their skins, that they have beene seene to fly 30 or 40 yards.[1]

This species was described more or less fully also in the seventeenth and eighteenth centuries by numerous other writers, including Ray,[2] Catesby,[3] and Edwards.[4] Both Catesby and Edwards figured the animal, and Catesby described its habits in the following words:

> These Squirrels are gregarious, travelling from one Tree to another in companies of ten, or twelve together. When I first saw them, I took them for dead Leaves, blown one Way by the Wind, but was not long so deceived, when I perceived many of them to follow one another in one Direction: They will fly fourscore Yards from one Tree to another. They can not rise in their Flight, nor keep in a horizontal Line, but descend gradually, so that in Proportion to the Distance the Tree, they design to fly to, is from them, so much the higher they mount on the Tree they fly from * * *.

The species of eastern Canada was briefly described by Sagard-Théodat in 1636,[5] and that of southern Mexico by Hernandez in 1651.[6]

GENERIC NAMES.

Placed first by Linnæus in the genus *Mus*, the American flying squirrels were later associated with *Sciurus* by Gmelin, Pallas, and Shaw. In 1800 G. Cuvier proposed a new genus, *Pteromys*, to include the European flying squirrel (*Sciurus volans* Linnæus) and the large East Indian species (*Sciurus petaurista* Gmelin). The American forms were referred by later writers to this genus. F. Cuvier, in 1823,[7] pointed out the characters distinguishing the American and European flying squirrels from the large Asiatic species, and in 1825 proposed the name *Sciuropterus* for the European animal,[8] but this name was not generally accepted until Allen adopted it for the American species in his monograph of the Sciuridæ (1877).[9] This name continued in current use until 1914, when Miller[1] showed that according to modern rules for fixing types it must give place to *Pteromys* of earlier date, the type of the latter having been fixed by Fleming,[2] in 1822, on *Sciurus volans*—the European flying squirrel. Thomas,[3] in 1908, in a revision of the genera of flying squirrels separated the American forms subgenerically from the European members of the genus under the name *Glaucomys*, and in 1915 the present writer raised the group to generic rank.[4]

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[1] Smith, John, The Generall Historie of Virginia, &c., p. 27, 1624.

[2] Ray, John, Synop. Quad., p. 215, 1693.

[3] Catesby, Mark, Nat. Hist. Carolina, II, pp. 76–77, 1743.

[4] Edwards, George, Nat. Hist. Birds, IV, p. 191, 1751.

[5] Sagard-Théodat, Gabriel, Hist. Canada, III, p. 745, 1636.

[6] Hernandez, F., Hist. Anim. et Min. Novæ., Hisp., p. 9, 1651: In Rerum Med. Novæ Hisp. Thesaurus.

[7] Cuvier, F., Mem. Mus. Hist. Nat., Paris, pp. 125–127, 1823.

[8] Cuvier, F., Dents des Mamm., p. 255, 1825.

[9] Allen, J. A., Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr., XI, p. 653, 1877.

SPECIFIC NAMES.

Linnæus, in the 10th edition of his Systema Naturæ,[5] described the smaller American species under the name *Mus volans*, basing his description mainly on the account of the animal as given by Ray. Curiously enough, on a later page of the same work he described the European flying squirrel as *Sciurus volans*. The two species naturally were united in one genus by later authors, and the duplication of the name *volans* necessitated the renaming of one of them. Pallas, therefore, in 1778,[6] proposed the name *volucella* for the American animal, which designation remained in general use until 1890, when Jordan revived the original name *volans*.[7] The larger American species was named *Sciurus hudsonius*, in 1788, by Gmelin,[8] but this name proved to be preoccupied by Erxleben's *Sciurus vulgaris hudsonicus* applied to the American chickaree, so, in 1801, Shaw proposed in its place the name *sabrinus*.[9] During the nineteenth century both these names were used for the northern flying squirrel—*hudsonius* by Baird, Allen, and others and *sabrinus* by Richardson, Audubon and Bachman, and others. Finally, in 1894, the nomenclatural question involved having been settled, Rhoads[10] revived the name *sabrinus*, which has remained current ever since. In addition to Pallas's name *volucella*, the small species *Mus volans* Linnæus was several times renamed during the early years of the nineteenth century. Tiedemann, in 1808, proposed for it the name *Pteromys virginianus*,[11] and Oken, in 1816, called the species *Pteromys americana*.[12]

Richardson, in 1828,[13] described a new species, *alpinus*, from material collected by Thomas Drummond in western Canada, but the following year he reduced the form to a subspecies of *sabrinus*.[1] Bachman, in 1839, named *oregonensis*, a new species from the lower Columbia River, and after this date no new names were proposed for the group for a period of more than 50 years.

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[1] Miller, G. S., Proc. Biol. Soc. Washington, XXVII, p. 216, 1914.
[2] Fleming, J., Philos. Zool., II, p. 190, 1822.
[3] Thomas, O., Ann. and Mag. Nat. Hist. (ser. 8), I, p. 5, 1908.
[4] Howell, A. H., Proc. Biol. Soc. Washington, XXVIII, p. 109, 1915.
[5] Linnæus, Syst. Nat., Ed. 10, I, p. 63, 1758.
[6] Pallas, Nov. Spec. Glires, p. 351, 1778.
[7] Jordan, D. S., Man. Vert. U. S., Ed. 5, 321, 1890.
[8] Gmelin, J. F., Syst. Nat., I, p. 153, 1788.
[9] Shaw, Gen. Zool., II, p. 157, 1801.
[10] Rhoads, S. N., Amer. Nat., XXVIII, p. 525, 1894.
[11] Tiedemann, F., Zool., I, p. 451, 1808.
[12] Oken, Lorenz, Lehrb. der Naturg., II, p. 865, 1816.
[13] Richardson, J., Zool. Journ., III, p. 519, 1828.

Audubon and Bachman in their great work, the Quadrupeds of North America,[2] treated the four species already described—*volucella*, *sabrinus*, *alpinus*, and *oregonensis*. Baird, in his Mammals of North America,[3] recognized the same four species (using the name *hudsonius*, however, in place of *sabrinus*), but was able to add very little to the history of the group. Allen, in his Monograph of the Sciuridæ,[4] united the four forms into one species, *volucella*, with *hudsonius* as a variety, placing *alpinus* and *oregonensis* in synonymy. Bangs, in 1896, revised the eastern members of the genus, raising *sabrinus* again to the rank of a species and describing as new, *querceti*, a southern race of *volans*, and *silus*, a supposed new species from West Virginia.[5] Rhoads, in 1897, revised the western forms of the genus, reviving *alpinus* as a full species with *oregonensis* as a subspecies and describing three additional races—*fuliginosus* from the Cascade Mountains, Washington; *bangsi* from central Idaho; and *californicus* from the San Bernardino Mountains, California.[6]

During the next eight years 9 new forms were added by various authors to the 9 already recognized—one (*goldmani*) as a race of *volans* from southern Mexico, two (*macrotis* and *makkovikensis*) as races of *sabrinus*, five (*klamathensis*, *olympicus*, *lascivus*, *stephensi*, and *zaphæus*) as races of *alpinus*, and one (*yukonensis*) as a full species.

In 1915 Swenk proposed as new *Pteromys volans nebrascensis*, and the present writer described two races of *volans*, four of *sabrinus*, and one full species, *bullatus*,[7] thus raising the total number of recognized forms to 26. In the present revision all of these are recognized except *silus* of Bangs and *nebrascensis* of Swenk, which are referred to *G. volans volans*.

GENERIC CHARACTERS.

Form sciurine; fore and hind limbs connected by a broad fold of skin extending from wrists to ankles, supported anteriorly by a slender cartilaginous process growing from the wrist. Tail broad, much flattened, densely haired, its sides usually nearly parallel or slightly narrowed at each end, the tip evenly rounded. Soles with 4 tubercles at base of toes; no metatarsal pad; palms with 5 tubercles—3 at base of fingers, one at base of the rudimentary thumb, and one opposite the latter on outside of wrist. Mammæ, 8, as follows: Pectoral, $\frac{1}{1}$; abdominal, $\frac{2}{2}$; inguinal, $\frac{1}{1}$. Skull with smoothly rounded braincase, flattened in some species, subglobular in others; nasals abruptly depressed at tip; dorsal outline of skull from nasals to postfrontal region nearly straight, then abruptly depressed to occiput; frontals long and narrow, the interorbital region decidedly longer than broad; interorbital constriction pronounced, usually with a distinct notch at anterior base of postorbital processes; postorbital processes broad at base, tapering abruptly to a point, slightly depressed at tip; zygomata moderately expanded posteriorly, less widely anteriorly; audital bullæ large, subcircular in outline, smoothly rounded; pterygoids slender and rather low, the hamular processes usually touching audital bullæ; dentition, I, $\frac{1}{1}$; PM, $\frac{2}{1}$; M, $\frac{3}{3}=22$; maxillary toothrows approximately parallel; anterior upper premolar very small, terete, its crown simple; transverse ridges of upper molariform teeth continuous.

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[1] Fauna Boreali-Amer., I, p. 195, 1829.

[2] Audubon and Bachman, Quad. North Amer., I, pp. 132, 216, 1846; III, pp. 202, 206, 1854.

[3] Baird, S. F., Mamm. North Amer.: Rept. Expl. and Surv. R. R. Pac., VIII, pp. 286–290, 1857.

[4] Allen, J. A., Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr., XI, pp. 653–666, 1877.

[5] Bangs, O., Proc. Biol. Soc. Washington, X pp. 162–166, 1896.

[6] Rhoads, S. N., Proc. Acad. Nat. Sci. Philadelphia, pp. 314–327, 1897.

[7] Howell, A. H., Proc. Biol. Soc. Washington, XXVIII, pp. 109–114, 1915; in the present paper *bullatus* is treated as a subspecies of *sabrinus*.

The skull of *Glaucomys* differs from that of *Pteromys*[1] in the following particulars (see Pl. VII, figs. 11–14): Rostrum with sides not parallel, but tapering gradually from tip to point of union with the zygomata; nasal branches of premaxillæ relatively much wider; zygomata narrower anteriorly, not standing out squarely from the rostrum; maxillary arm of zygoma much weaker, the median portion of the arch nearly vertical (nearly horizontal in *Pteromys*); frontals relatively longer and narrower, the surface nearly flat or with a very slight depression; postorbital processes broader at the base and less attenuate; braincase more swollen, its outlines smooth and rounded; occiput not noticeably depressed; anterior palatine foramina relatively smaller; mandible relatively longer and more slenderly built, the masseteric ridge less strongly developed, terminating at a point slightly posterior to the premolar; angular process weaker, its border forming a regular curve (not abruptly bent outwards, as in *Pteromys*); coronoid process larger and longer; enamel pattern of molariform teeth simple, the transverse ridges of the upper molars complete (in *Pteromys* PM^4, M^1, and M^2 having the posterior ridge cut by a deep reentrant fold).

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[1] As restricted to the small palæarctic species *P. volans*, *P. büchneri*, and related forms.

List of Species and Subspecies, with Type Localities.

Glaucomys volans group:	
Glaucomys volans volans (Linnæus)	Virginia.
volans saturatus Howell	Dothan, Alabama.
volans querceti (Bangs)	Citronelle, Florida.
volans texensis Howell	Sour Lake, Texas (7 miles northeast).
volans goldmani (Nelson)	Teopisca, Chiapas (20 miles southeast).
Glaucomys sabrinus group:	
Glaucomys sabrinus sabrinus (Shaw)	Mouth of Severn River, Ontario.
sabrinus makkovikensis (Sornborger)	Makkovik, Labrador.
sabrinus macrotis (Mearns)	Hunter Mountain (Catskills), Greene County, New York.
sabrinus canescens Howell	Portage la Prairie, Manitoba.
sabrinus bangsi (Rhoads)	Idaho County, Idaho.
sabrinus alpinus (Richardson)	Jasper House, Alberta.
sabrinus yukonensis (Osgood)	Camp Davidson, Yukon River, Yukon.
sabrinus zaphæus (Osgood)	Helm Bay, Cleveland Peninsula, Alaska.
sabrinus oregonensis (Bachman)	"Pine woods of the Columbia, near the sea"—probably near the present site of St. Helens, Oregon.
sabrinus columbiensis Howell	Okanogan, British Columbia.
sabrinus fuliginosus (Rhoads)	Cascade Mountains, near Martin Station, Kittitas County, Washington.
sabrinus latipes Howell	Glacier, British Columbia.
sabrinus olympicus (Elliot)	Happy Lake, Olympic Mountains, Washington.
sabrinus bullatus Howell	Sawtooth [Alturas] Lake, Idaho.
sabrinus klamathensis (Merriam)	Fort Klamath, Oregon.
sabrinus flaviventris Howell	Head of Bear Creek, Trinity County, California.
sabrinus lascivus (Bangs)	Tallac, Eldorado County, California.
sabrinus californicus (Rhoads)	Squirrel Inn, San Bernardino Mountains, California.
sabrinus stephensi (Merriam)	Sherwood, Mendocino County, California.

Key to Species and Subspecies.

a^1. Hairs on belly white at roots (*volans* group).
  b^1. Colors paler (drab, pinkish cinnamon, or yellowish wood brown).
    c^1. Size larger; hind toes white in winter pelage ---------- **volans** (p. 19).
    c^2. Size smaller; hind toes not white in winter.
      d^1. Skull relatively short and broad (greatest length, 32.7–34 mm.); bullæ smaller ---------- **texensis** (p. 27).
      d^2. Skull relatively long and narrow (greatest length, 33.2–35.3); bullæ larger ---------- **querceti** (p. 26).

- b^2. Colors darker (dark sayal brown; hair brown; pale snuff brown).
  - c^1. Sides of face marked with fuscous---- **goldmani** (p. 28).
  - c^2. Sides of face not marked with fuscous---- **saturatus** (p. 24).
- a^2. Hairs on belly gray at roots (*sabrinus* group).
  - b^1. Bullæ very large---- **bullatus** (p. 51).
  - b^2. Bullæ medium or small.
    - c^1. Soles yellowish.
      - d^1. Underparts strongly yellowish---- **flaviventris** (p. 54).
      - d^2. Underparts not strongly yellowish.
        - e^1. Underparts tinged with yellow or cream-buff.
          - f^1. Under side of tail darker (deep pinkish cinnamon), **columbiensis** (p. 45).
          - f^2. Under side of tail paler (light pinkish cinnamon or colonial buff)---- **klamathensis** (p. 52).
        - e^2. Underparts tinged with avellaneous---- **lascivus** (p. 55).
    - c^2. Soles not yellowish.
      - d^1. Underparts heavily washed with wood brown or some shade of cinnamon or buff.
        - e^1. Upperparts strongly rufescent (mikado brown or pecan brown), **oregonensis** (p. 44).
        - e^2. Upperparts not strongly rufescent.
          - f^1. Tail strongly clouded with fuscous beneath---- **zaphæus** (p. 43).
          - f^2. Tail not strongly clouded with fuscous beneath.
            - g^1. Size larger (greatest length of skull usually more than 42 mm.), **latipes** (p. 48).
            - g^2. Size smaller (greatest length of skull usually less than 42 mm.).
              - h^1. Colors darker (wood brown to snuff brown), **olympicus** (p. 49).
              - h^2. Colors paler (pale sayal brown)---- **fuliginosus** (p. 47).
      - d^2. Underparts whitish, or moderately washed with wood brown or some shade of cinnamon or buff.
        - e^1. Upperparts vinaceous or brownish (pinkish cinnamon, vinaceous-cinnamon, or sayal brown).
          - f^1. Upperparts very pale (light pinkish cinnamon)---- **canescens** (p. 37).
          - f^2. Upperparts darker (vinaceous-cinnamon to sayal brown).
            - g^1. Underparts white or faintly washed with pinkish cinnamon or wood brown.
              - h^1. Size larger (greatest length of skull in adults more than 39 mm.).
                - i^1. Under side of tail strongly washed with fuscous or dark brown.
                  - j^1. Size larger (greatest length of skull usually more than 40.4 mm.)---- **makkovikensis** (p. 34).
                  - j^2. Size smaller (greatest length of skull usually less than 40.4 mm.)---- **sabrinus** (p. 31).
                - i^2. Under side of tail not strongly washed with fuscous (pale or deep pinkish cinnamon).
                  - j^1. Upperparts vinaceous-cinnamon---- **columbiensis** (p. 45).
                  - j^2. Upperparts sayal brown---- **stephensi** (p. 57).
              - h^2. Size smaller (greatest length of skull less than 39 mm.), **macrotis** (p. 35).

g^2. Underparts moderately washed with pinkish cinnamon or avellaneous.
  h^1. Size larger (average length of tail about 165 mm.), yukonensis (p. 41).
  h^2. Size smaller (average length of tail about 142 mm.), bangsi (p. 38).
e^2. Upperparts drab, gray, or wood brown.
  f^1. Size larger; tail heavily marked with fuscous------alpinus (p. 40).
  f^2. Size smaller; tail not heavily marked with fuscous.
    g^1. Under side of tail deep pinkish cinnamon------bangsi (p. 38).
    g^2. Under side of tail pinkish buff or pale olive-buff.
      h^1. Skull with deeper braincase; soles never washed with yellow or buff------stephensi (p. 57).
      h^2. Skull with shallower braincase; soles often washed with yellow or buff.
        i^1. Larger and darker------lascivus (p. 55).
        i^2. Smaller and paler------californicus (p. 56).

DESCRIPTIONS OF SPECIES AND SUBSPECIES.

Glaucomys volans Group.

GLAUCOMYS VOLANS (LINNÆUS).

[Synonymy under subspecies.]

General characters.—Size small (hind foot 32 mm. or less); hairs on underparts white to the roots, except on hind legs and flying membranes, where they are plumbeous at base.

Cranial characters.—Skull small (greatest length 35.7 mm. or less); rostrum short; audital bullæ moderately inflated.

Color.—Upperparts drab, pinkish cinnamon, sayal brown, pale snuff brown, hair-brown, or yellowish wood brown, the bases of the hairs deep neutral gray; sides of face smoke gray, often shaded with fuscous or buff; borders of flying membrane above, fuscous, clove brown, or blackish brown; fore feet buffy white, hair-brown, or grayish buff; hind feet hair-brown, fuscous, or mouse gray, the toes in one race white in winter; tail above, hair-brown, snuff brown, verona brown, fuscous, or drab; beneath, pinkish cinnamon, vinaceous-cinnamon, or pinkish buff; underparts creamy white, the sides often edged with pinkish cinnamon, vinaceous-cinnamon, or pinkish buff.

Geographic distribution.—Eastern United States and extreme southern Canada, from southern New Hampshire, northern New York (Lewis County), southern Ontario (London), central Michigan, northern Wisconsin (Burnett County), and central Minnesota (Aitkin County), south to the Gulf coast and southern Florida (Fort Myers); west to eastern Nebraska (Otoe and Nemaha Counties), eastern Kansas (Douglas and Woodson Counties), southwestern Oklahoma (Wichita Mountains), and eastern Texas (Parker, Bastrop, and DeWitt Counties); also the highlands of Chiapas and

Guatemala and probably locally throughout eastern Mexico. Zonal range from the Transition through Upper and Lower Austral Zones (fig. 2).

GLAUCOMYS VOLANS VOLANS (LINNÆUS).

SMALL EASTERN FLYING SQUIRREL.

[Pl. I; Pl. II, fig. 2; Pl. IV, fig. 2; Pl. VI, fig. 1.]

[***Mus***] ***volans*** Linnæus, Syst. Nat., ed. 10, p. 63, 1758 (based chiefly on Ray and Edwards).

Sciurus volucella Pallas, Nov. Spec. Glires, p. 351, 1778 (apparently a renaming of ***Mus volans*** Linnæus, but based primarily on Edwards and Catesby).

Pteromys virginianus Tiedemann, Zool., I, p. 451, 1808 (renaming of *Mus volans* Linnæus).

Pteromys americana Oken, Lehrb. der Naturg., II, p. 865, 1816 (renaming of *Sciurus volucella* Pallas).

Pteromys volucella Desmarest, Nouv. Dict. d'Hist. Nat., XXVII, p. 406, 1818; Audubon and Bachman, Quad. North Amer., I, p. 216, 1846, plate XXVIII; Baird, Mamm. North Amer.: Rept. Expl. and Surv. R. R. Pac., VIII, p. 286, 1857.

Sciuropterus volucella Lesson, Manual de Mamm., p. 242, 1827.

Sciuropterus americanus Desmarest, Dict. Sci. Nat., p. 140, 1827.

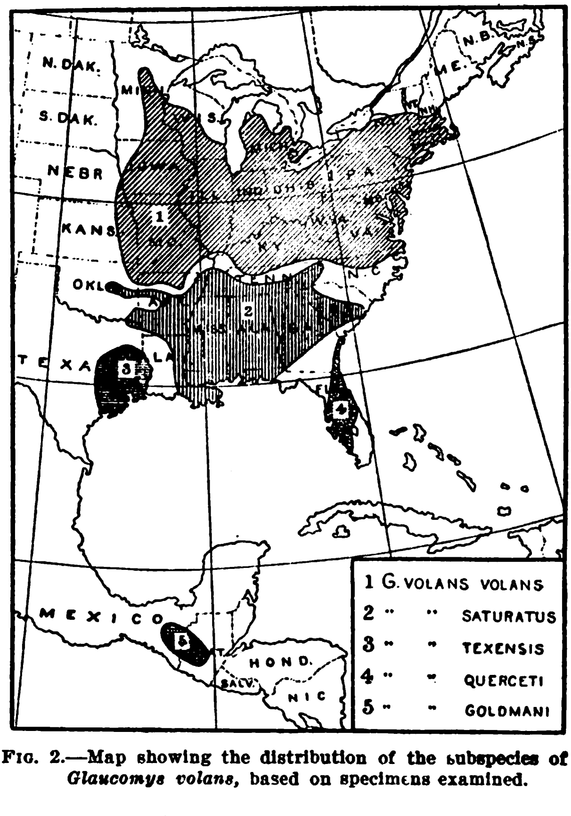

FIG. 2.—Map showing the distribution of the subspecies of *Glaucomys volans*, based on specimens examined.

? ***Pteromys cucullatus*** Fischer, Synop. Mamm., p. 365, 1829 (type locality, Virginia (?); based on the "*Sciurus, Virginianus, volans*" of Seba).[1]

Sciuropterus volucella var. *volucella* Allen, Proc. Boston Soc. Nat. Hist., XVI, p. 189, 1874; Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr., XI, p. 655, 1877.

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[1] Seba's figure does not agree with any known species of flying squirrel; Thomas (Proc. Zool. Soc. London, p. 148, 1911) has identified it as a young *Petaurista*, but the flattened tail strongly suggests *Glaucomys;* Linnæus cites Seba's description in the synonymy of *Mus volans*.

S[ciuropterus] volans Jordan, Man. Vert. U. S., ed. 5, p. 321, 1890.

Sciuropterus silus Bangs, Proc. Biol. Soc. Washington, X, p. 163, 1896. Type, No. 4931, Mus. Comp. Zool. (formerly in collection E. A. & O. Bangs); from top of Katis Mountain, near White Sulphur Springs, West Virginia; September 2, 1895.

Pteromys volans nebrascensis Swenk, University Studies (Lincoln, Nebraska), XV, p. 151, "April" [= Sept. 25], 1915. Type, No. 286, Coll. State Entomologist, Univ. Nebraska; from Nebraska City, Nebr., Nov. 26, 1914.

Type locality.—Virginia.[1]

Distribution.—Northeastern United States and extreme southern Canada, from central Minnesota, Wisconsin, and Michigan, southern Ontario, northern New York (Lewis County), and southern New Hampshire south to North Carolina (Raleigh), Tennessee (Nashville), and northern Arkansas and Oklahoma (Boston Mountains); west to eastern Nebraska (Otoe and Nemaha Counties) and eastern Kansas (Douglas and Woodson Counties).

Characters.—Size large (for the group); colors pale; upperparts varying from drab to pinkish cinnamon; toes, in winter, usually strongly marked with white and soles haired to the bases of the toes.

Color.—*Winter pelage:* Upperparts varying from drab through numerous intermediate shades to pinkish cinnamon, shaded along sides with pinkish buff; hairs on back with an indistinct, subterminal band of brown (not visible on the surface), their bases deep neutral gray; sides of face smoke gray, often washed with pinkish buff; eye-ring fuscous or clove brown; ears hair-brown or drab, scantily haired; upper surface of flying membrane fuscous to blackish brown; under surface edged with light pinkish cinnamon; underparts white, with a creamy tinge, the hairs white to the roots (except on hind legs, where their bases are neutral gray); tail, above, snuff brown to drab, shading on sides to hair-brown; beneath, light pinkish cinnamon to pinkish buff, shaded in some specimens with drab-gray; front feet buffy white or hair-brown, sometimes shaded with gray; hind feet hair-brown (rarely mouse gray), the toes and inner borders of feet white. *Summer pelage:* Similar to the winter pelage, but general tone of upperparts usually darker, caused in part by reddening of the hairs and in part by wearing away of the tips, thus exposing portions of the underfur; toes without white markings; middle portion of soles naked.

Molt.—From the large series of skins of this race which have been examined it has been possible to assemble a series of 97 specimens representing every month in the year and showing fully all the pelage gradations from one season to another. The following notes on the pelage of these specimens, arranged chronologically, will serve to make clear the time and manner of molting:

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[1] Fixed by Elliot, Synop. Mamm. North Amer.: Field Columb. Mus., Zool. Ser., II, p. 109, 1901 (see also Thomas, Proc. Zool. Soc. London, p. 148, 1911).

December.—Five specimens, all in full unworn pelage; hind feet white, the soles fully haired.

January.—Seven specimens, all in full unworn pelage excepting one (Virginia, January 18), which is slightly worn on rump; hind feet of all, white; soles haired.

February.—Eight specimens, all in full unworn pelage; hind feet white and soles haired.

March.—Fourteen specimens; ten in full unworn pelage; four adults (Washington, D. C., March 1) show considerable wear on head, nape, and rump; one immature specimen (White Sulphur, West Virginia, March 1) is slightly worn on head; all have white feet and hairy soles.

April.—Thirteen specimens; four in full pelage showing little wear; six much worn on head and nape; two considerably worn on entire upperparts and one on flanks; all but one have white feet and all but one (Long Island, New York, April 15), hairy soles.

May.—Seven specimens; two young individuals (Maryland, May 13) in much-worn pelage have brown feet, the soles hairy; one young from Wisconsin (June 10) is similar, but shows little wear; one adult (West Virginia, May 17) is in full pelage, but has brown feet and naked soles; two adults in full unworn pelage, except on head, have white feet but naked soles; one adult (Mount Graylock, Mass., May 6) is slightly worn on head, having white feet and hairy soles.

June.—Eight specimens; four moderately worn; three in full unworn pelage; one worn on head only; one (Washington, D. C., June 20) practically same as winter specimens (except feet); feet dusky, without white markings (except in one from Massachusetts, June 27, in which white on toes is faintly indicated.)

July.—Eleven specimens; three young nearly full grown (July 23, 27); two from Massachusetts (July 3, 26), practically full-grown young, show considerable wear; adults show only moderate wear on body, considerable on tail; one (July 28, Washington, D. C.) has pelage as full as in winter, but redder; feet dusky; soles naked.

August.—Two specimens; one (Lake George, New York, August 30) is somewhat worn on head, very little on body; another (Massachusetts, August 30) shows considerable wear on upperparts and tail; feet dusky.

September.—Eight specimens; four show little wear; two young are considerably worn; one adult (September 6, Maryland) is much worn, especially on nape and tail; one (Lake George, New York, September 15) has practically completed the body molt, except on head and a small area in middle of hinder back; feet dusky and soles naked.

October.—Five specimens; one young (October 21) shows little wear; one adult (Sing Sing, N. Y., October 17) apparently still retains the old pelage, which is little worn except on head and tail; feet noticeably whitened, but soles naked; three adults (Massachusetts, October 21; Virginia, October 19) are molting all over the upperparts, the feet still dusky and soles naked.

November.—Nine specimens; two immature individuals from Maryland are much worn and in process of molting; one adult from Maryland (♂, November 9) still retains old pelage on back, being much worn on head and nape, but fresh pelage seems to be coming in on sides of body; feet drab without white markings and soles naked; one adult (Washington, D. C., November 1) has completed the body molt except on head and a patch on nape; the toes on hind feet are slightly whitened, and the hair is encroaching on the soles; five adults from Connecticut (November 26) are in full winter pelage, with white feet and hairy soles.

Skull.—Largest of the group; superior outline straight from nasals to postfrontal region; braincase moderately depressed, squarish in general outline.

Measurements.—Average of 16 adults from District of Columbia and adjacent parts of Virginia and Maryland: Total length, 232 (220–240); tail vertebræ, 101 (90–110); hind foot, 30.4 (29–32). *Skull:* Average of 12 adults from District of Columbia: Greatest length, 34.9 (34.1–35.6); zygomatic breadth, 21 (20.4–22.2); mastoidal breadth, 17.1 (16.5–17.7); least interorbital breadth, 6.9 (6.2–7.6); least postorbital breadth, 9.1 (8.6–9.6); length of nasals, 9.6 (9.2–10.1); maxillary toothrow, 6.4 (6.2–6.7).

Type specimen.—None known to exist.

Remarks.—This flying squirrel has an extensive range, and although individual variation within the subspecies is considerable, there is practically no variation which can be correlated with faunal areas. Large series of specimens are available from nearly all parts of its range, and careful comparison fails to reveal any appreciable differences between those of the New England States on the one hand and those of Minnesota, Iowa, Kansas, and Nebraska on the other. On the southern border of the range, however, a gradual darkening of the color of the upperparts is noticeable, and also a tendency toward elimination of white on the toes in winter pelage. Specimens from Virginia (the type region), however, do not differ appreciably from New England and New York individuals. Specimens from Raleigh, N. C., and from Stillwell, Okla., show decided approach in characters to *saturatus;* a single winter specimen from Gainesville, Tex., although approaching *texensis* in skull characters, agrees almost exactly with typical *volans* in color and in having white toes. Since this specimen shows no approach to *saturatus* (which occurs at Red Fork, in the Arkansas Valley), it seems probable that typical *volans* ranges from Kansas into western Oklahoma, perhaps as far as the Wichita Mountains, and thence into northern Texas. A single specimen in summer pelage from Oklahoma City, although somewhat indeterminate in characters, seems to bear out this theory of distribution. Additional material from that part of Oklahoma is needed to settle the question.

The type of *Sciuropterus silus* Bangs has been examined and proves to be an immature individual of *volans*, evidently a runt. A considerable series is now available from the type locality of *silus*, and all are perfectly typical of *volans*.

The type of *Pteromys volans nebrascensis* Swenk has been examined and found to agree essentially with typical specimens of *volans* from the vicinity of Washington, D. C. It is a rather pronounced example of the gray phase, and, although taken on November 26, the hind toes have not yet acquired the clear white which characterizes the winter pelage. The hind feet are somewhat darker than the average of *volans*—in this respect agreeing with *saturatus*. The tail measurement of the type (115 mm.) is about 14 mm. more than the average, but only 5 mm. more than the extremes of *volans*. In the dried skin, however, the tail does not measure any longer than in dozens of typical specimens. The skull and hind feet measure exactly as in typical examples.

Specimens examined.—Total number, 356, as follows:

Connecticut: East Hartford, 5;[1] Liberty Hill, 8.[2]
District of Columbia: Cleveland Park, 13; Washington, 23.
Illinois: Belleville, 1; Chicago, 2; Golconda, 1;[3] Olive Branch, 1;[3] Olney, 2; Parkersburg, 1; Warsaw, 8; Willow Springs, 1.[3]
Indiana: Denver, 2;[2, 4] Kankakee, 1;[3] La Porte, 1;[3] Wheatland, 1.
Iowa: Hillsboro, 2; Iowa City, 1;[5] Knoxville, 3; Thayer, 2.[5]
Kansas: Douglas County, 5;[6] Lawrence, 11;[5] Topeka, 4;[6] Woodson County, 1.[7]
Kentucky: Eubanks, 3.
Maryland: Bacon Hill, 3;[8] Branchville, 1; Capitol View, 1; Garrett Park, 1; Kensington, 2; Laurel, 3; Marlboro, 1; Marshall Hall, 2; Oxon Hill, 1; Plummer Island, 2; Prince Georges County, 3; Silver Spring, 2.
Massachusetts: Ipswich, 1; Mount Graylock, 1; Wareham, 4;[2] Waverly, 2;[2] Wilmington, 2; Woburn, 1.
Michigan: Ann Arbor, 4;[4] Brooklyn, 1;[4] Dexter, 1;[4] Iosca, 1;[4] Ithaca, 2;[4] Kavanagh Lake, 3;[4] Lodi Township, Washtenaw County, 1;[4] Napoleon, 1;[4] Portage Lake, 2;[4] Sand Point, 10;[4] Ypsilanti, 1.[4]
Minnesota: Aitkin, 1;[8] Bridgman, 2; Elk River, 19; Fort Snelling, 3; Steele County, 2.[8]
Missouri: Independence, 1; Stotesbury, 1.[2]
New Hampshire: Hancock, 2.[2]
New Jersey: Cape May County, 1;[9] Culvers Gap, Sussex County, 1;[8] Ellenville, 1; Haddonfield, 5;[8] Lake Hopatcong, 4;[8] Seaville, 2.[8]
New York: Ardsley, 3;[8, 9] Geneva, 1; Hastings, 7;[9] Jamaica, 1; Lake George, 5; Lake Grove, 2; Locust Grove, 5; Miller Place, 5;[9] Sing Sing, 7; Suffolk County, 1.[8]
North Carolina: Apex, 1;[8] Raleigh, 20.[10]
Ohio: Fort Ancient, 1;[9] Madisonville, 3; Ravenna, 1.[9]
Oklahoma: Oklahoma City, 1; Stilwell, 7.
Ontario: Kingsville, 1;[11] London, 7.[11]

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[1] Three in collection Acad. Nat. Sci. Philadelphia.
[2] Collection Mus. Comp. Zool.
[3] Collection Field Mus. Nat. Hist.
[4] Collection Univ. Michigan.
[5] Collection D. Stoner, Iowa City, Iowa.
[6] Collection Kansas Univ. Mus.
[7] Collection Colorado Mus. Nat. Hist.
[8] Collection Acad. Nat. Sci. Philadelphia.
[9] Collection Amer. Mus. Nat. Hist.
[10] Nine in collection Amer. Mus. Nat. Hist.
[11] Collection W. E. Saunders, London, Ont.

Pennsylvania: Carlisle, 1; Chester County, 2; Drury Run, Clinton County, 1; Huntingdon Furnace, 1;[1] Leasuresville, 3;[1] Moon Township, Allegheny County, 1;[2] Pine Grove Furnace, 1.[2]

Tennessee: Nashville, 1.[3]

Texas: Gainesville, 2.

Vermont: Castleton, 1;[4] Rutland, 2.[4]

Virginia: Cherrydale, 1; Dranesville, 1; Dunn Loring, 4; Falls Church, 8; Fort Myer, 1; Henrico County, 1; Maywood, 1; Mount Rodgers, Grayson County, 2; Mount Vernon, 7; Nelson County, 2;[3] Suffolk, 1; Warwick County, 2.

West Virginia: Travellers Repose, 2; White Sulphur Springs, 13.[5]

Wisconsin: Beaver Dam, 2;[6,7] Cassville, 1;[3] Delavan, 1; Lake Koshkonong, 1;[7] Racine, 1.

GLAUCOMYS VOLANS SATURATUS Howell.

Southeastern Flying Squirrel.

[Pl. II, fig. 1; Pl. IV, fig. 1; Pl. VI, fig. 3.]

Glaucomys volans saturatus Howell, Proc. Biol. Soc. Washington, XXVIII, p. 110, May 27, 1915.

Type locality.—Dothan, Alabama.

Distribution.—Southeastern United States (excepting peninsular Florida and the coast region of Georgia) from South Carolina and western North Carolina west to central Oklahoma and north in the Mississippi Valley to southwestern Kentucky.

Characters.—Similar in size and skull characters to *volans*, but upperparts darker at all seasons; toes not conspicuously whitened in winter. Compared with *querceti:* Colors averaging darker, face grayer (less buffy), and hind feet grayer (less brownish); soles haired in winter.

Color.—*Winter pelage:* Upperparts pale snuff brown or dark sayal brown, varying to hair-brown; sides of face smoke gray, rarely with a tinge of buff; upper surface of flying membrane dark clove brown or blackish brown; hind feet hair-brown, the toes washed with buff; fore feet grayish buff; tail above, snuff brown, shaded with bister or dark hair-brown (rarely solid hair-brown); beneath, pinkish cinnamon or vinaceous-cinnamon (rarely light hair-brown, washed with pinkish cinnamon); underparts creamy white, the under surface of the membranes edged with light pinkish cinnamon or light vinaceous cinnamon. *Summer pelage:* Essentially as in winter, but hind feet fuscous. *Variation* (March specimens from Milton, Florida): Upperparts rich pecan brown.

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[1] Collection Acad. Nat. Sci. Philadelphia.

[2] Collection Carnegie Mus.

[3] Collection Mus. Comp. Zool.

[4] Collection G. L. Kirk, Rutland, Vt.

[5] Ten in collection Mus. Comp. Zool.; two in Field Mus. Nat. Hist.

[6] Collection Mus. Vert. Zool., Univ. California.

[7] Collection E. R. Warren, Colorado Springs, Colo.

Skull.—Closely similar to that of *volans*, but averaging smaller; practically same size as that of *querceti*, but bullæ averaging smaller.

Measurements.—Average of 12 adults from southern Alabama:[1] Total length, 226 (211–244); tail vertebræ, 100 (84–109); hind foot, 30 (28–33). *Skull:* Average of 10 adults from southern Alabama:[2] Greatest length, 34 (32.8–34.9); zygomatic breadth, 20.3 (19.9–21.1); mastoidal breadth, 17 (16.6–17.5); least interorbital breadth, 7 (6.7–7.8); least postorbital breadth, 8.9 (8.3–10); length of nasals, 9.4 (8.8–10); maxillary tooth row, 6.4 (6.2–6.8).

Type specimen.—No. 178366, U. S. Nat. Mus. (Biological Survey collection); ♀ ad., skin and skull; collected March 13, 1912, by A. H. Howell.

Remarks.—This race is the darkest form in the *volans* group, differing in this respect both from the Florida form (*querceti*) and from the Texas form (*texensis*). It is much darker than *volans*, both in winter and in summer. Its range is chiefly in the Lower Austral Zone, but extends into the Upper Austral in the mountains of eastern Tennessee and western North Carolina. Intergradation with *volans* is shown by a series from Magnetic City, foot of Roan Mountain, North Carolina, and with *querceti* by a series from Pinetucky, Ga. The Pinetucky specimens are typical of *saturatus* in skull characters, but average paler in color. By reason of lack of material from Louisiana, the relationship of this race to *texensis* and its western limits in that State can not be defined. Specimens from Red Fork, Okla., are typical but in the Boston Mountains intergradation with *volans* occurs.

Two specimens in full winter pelage from Milton, Fla., differ from typical *saturatus* in having the upperparts pecan brown instead of snuff brown. These at first were thought to represent an undescribed race, but the recent acquisition of 3 adult specimens from Muscogee, Fla., only a few miles from Milton, which do not differ in any way from typical *saturatus*, leads to the conclusion that the Milton specimens represent a color phase of this race.

Specimens examined.—Total number, 89, as follows:

Alabama: Ardell, 4; Autaugaville, 10; Carlton, 2; Dothan, 6; Greensboro, 2; Mobile, 4; Perdido River, 1; Sand Mountain, near Carpenter, 2; York, 1.
Arkansas: Delight, 2.
Florida: Milton, 2; Muscogee, 2.
Georgia: Columbus, 1; Okefenokee Swamp, 2; Pinetucky, 13; Reidsville, 2; Young Harris, 1.
Kentucky: Hickman, 1.

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[1] Dothan, Autaugaville, Carlton, and York.
[2] Dothan, Autaugaville, Carlton, and Greensboro.

Louisiana: Mer Rouge, 2; Powhatan Plantation, near Gibson, 1.[1]
Mississippi: Columbus, 1; Washington, 1.
North Carolina: Cranberry, 1; Magnetic City, foot of Roan Mountain, 9.
Oklahoma: Red Fork, 4.
South Carolina: Calhoun Falls, 4;[2] Cleora, 1; Greenville, 1; Plantersville, 3; Santee, 1.
Tennessee: Watauga Valley, 2.

GLAUCOMYS VOLANS QUERCETI (BANGS).

FLORIDA FLYING SQUIRREL.

[Pl. II, fig. 9; Pl. IV, fig. 9; Pl. VI, fig. 2.]

Sciuropterus volans querceti Bangs, Proc. Biol. Soc., Washington, X, p. 166, Dec. 28, 1896.
[*Sciuropterus volucella*] *querceti* Trouessart, Cat. Mamm., I, p. 402, 1897.

Type locality.—Citronelle, Florida.

Distribution.—Peninsular Florida (south at least to Fort Myers) and the coast region of Georgia.

Characters.—Very similar in size and color to *volans*, but upperparts averaging slightly darker; toes without conspicuous white markings in winter; soles partly naked at all seasons; skull with larger audital bullæ.

Color.—*Winter pelage:* Upperparts sayal brown to yellowish wood brown, shaded on sides and fore legs with pinkish buff or light pinkish cinnamon; upper surface of flying membrane blackish brown; ears fuscous; sides of face smoke gray, often clouded with fuscous or buff; hind feet pale fuscous, the toes grayish buff; front feet whitish buff; tail above, snuff brown or verona brown, shading (when worn) to dark hair-brown; beneath, pinkish buff or pinkish cinnamon; underparts creamy white, often irregularly shaded with pinkish buff or pinkish cinnamon, particularly along edges of flying membranes. *Summer pelage:* Essentially the same as in winter, but averaging slightly browner (less drab) above.

Skull.—Closely similar to that of *volans*, but averaging slightly smaller, with larger audital bullæ.

Measurements.—Average of 8 adults from Florida:[3] Total length, 229 (221–253); tail vertebræ, 94 (81–115); hind foot, 31 (30–32). *Skull:* Average of 13 adults from Florida:[4] Greatest length, 34.3 (33.2–35.3); zygomatic breadth, 20.5 (19.1–21.3); mastoidal breadth, 17.4 (16.8–18.4); least interorbital breadth, 7 (6.5–7.3); least postorbital breadth, 8.5 (8.2–8.9); length of nasals, 9.4 (8.7–10); maxillary toothrow, 6.4 (5.9–7.1).

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[1] Collection Mus. Comp. Zool.
[2] Collection Field Mus. Nat. Hist.
[3] Citronelle and Enterprise.
[4] Citronelle, Enterprise, Lake Harney, and New Berlin.

Type specimen.—No. 2451, Mus. Comp. Zool. (formerly same number, collection E. A. and O. Bangs); ♀ ad., skin and skull; collected September 17, 1894, by F. L. Small.

Remarks.—The Florida flying squirrel resembles *volans* very closely in color, but is easily distinguished in winter pelage by the absence of white markings on the toes and by naked soles. Compared with *saturatus* it averages considerably paler. The large size of the audital bullæ seems to be only an average character, for while pronounced in some specimens, others do not differ in this respect from typical *volans*. The type specimen has larger bullæ than have two topotypes and, indeed, can scarcely be matched in this character by any of the Florida specimens examined. Intergradation with *saturatus* takes place in southeastern Georgia. Specimens from St. Marys, Ga., agree in color with *querceti*, but have smaller bullæ; some individuals in the series have the hind toes marked with buffy white, but less extensively than in *volans*. Considerably more material from Florida and Georgia is needed to show the average characters and exact distribution of this race.

Specimens examined.—Total number, 67, as follows:

Florida: Citronelle, 3;[1] Enterprise, 10;[3] Fort Myers, 1;[1] Gainesville, 2;[3] Hernando County, 2; Lake Harney, 2; Nassau County, 2;[3] New Berlin, 13;[1] Ocala, 1; Shell Hammock, 2; Tarpon Springs, 9.[4]

Georgia: McIntosh County, 1;[1] Montgomery, 4;[1] St. Marys, 15.[1, 2, 5, 6]

GLAUCOMYS VOLANS TEXENSIS Howell.

TEXAS FLYING SQUIRREL.

[Pl. II, fig. 5; Pl. IV, fig. 5; Pl. VI, fig. 4.]

Glaucomys volans texensis Howell, Proc. Biol. Soc. Washington, XXVIII, p. 110, May 27, 1915.

Type locality.—Sour Lake, Texas (7 miles northeast).

Distribution.—Eastern Texas, west to Aledo, Gurley, Elgin, and Cuero; eastern limits of range unknown.

Characters.—Similar in color and size to *volans;* upperparts slightly more ochraceous; toes without conspicuous white markings; skull decidedly shorter and broader. Compared with *querceti:* Similar in color, but skull shorter, with smaller bullæ. Compared with *saturatus:* Colors much paler; skull shorter and broader.

Color.—Winter pelage (March): Upperparts yellowish wood brown to drab, shaded on sides and fore legs with pinkish buff; upper surface of flying membrane fuscous-black; ears fuscous; front feet buffy white; hind feet hair-brown or drab, the toes washed with buffy white; tail above, fuscous, shaded with snuff brown; beneath, light pinkish cinnamon; underparts creamy white. *Summer pelage:* A specimen from Colmesniel, Tex. (July 30), agrees essentially with the grayest April specimen from Sour Lake; a much worn specimen from Tarkington (November 23) is slightly more ochraceous than spring specimens.

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[1] Collection Mus. Comp. Zool.

[2] Three in collection Amer. Mus. Nat. His.; two in Field Mus. Nat. Hist.

[3] Collection Amer. Mus. Nat. Hist.

[4] Four in collection Amer. Mus. Nat. Hist.; three in Acad. Nat. Sci. Philadelphia.

[5] Collection Field Mus. Nat. Hist.

[6] Collection Mus. Vert. Zool., Univ. California.

Skull.—Similar to that of *saturatus*, but shorter and relatively broader; braincase more rounded, deeper, and more abruptly depressed posteriorly. Differs from *querceti* in the same characters and also in having smaller audital bullæ.

Measurements.—Average of 6 topotypes (adult): Total length, 229 (219–236); tail vertebræ, 104 (97–111); hind foot, 30.8 (30–31). *Skull:* Average of 5 topotypes (adult): Greatest length, 33.5 (32.7–34); zygomatic breadth, 20.9 (20.6–21.1); mastoidal breadth, 17.2 (17.1–17.4); least interorbital breadth, 7.2 (6.9–7.3); least postorbital breadth, 8.6 (8.2–8.9); length of nasals, 9.4 (9.2–9.8); maxillary toothrow, 6.3 (6.1–6.4).

Type specimen.—No. 136400, U. S. Nat. Mus. (Biological Survey collection); ♂ ad., skin and skull; collected March 15, 1905, by J. H. Gaut.

Remarks.—The Texas flying squirrel closely resembles both *volans* and *querceti* in color, but differs from them in skull characters. It is much paler than *saturatus*, which occupies the eastern Gulf States from Louisiana to Georgia. The material at hand is too scanty to show clearly the relationships and exact range of this form. Intergradation with *volans* is indicated by an intermediate specimen from Gainesville, Tex. (referred to *volans*), and doubtless intergradation takes place also with *saturatus* where their ranges meet.

Specimens examined.—Total number, 10, as follows:

Texas: Colmesniel, 1; Sour Lake, 6; Tarkington, 1; Texarkana, 1; Troup, 1.

GLAUCOMYS VOLANS GOLDMANI (NELSON).

MEXICAN FLYING SQUIRREL.

[Pl. II, fig. 6; Pl. IV, fig. 6.]

Sciuropterus volans goldmani Nelson, Proc. Biol. Soc. Washington, XVII, p. 148, Oct. 6, 1904.

Type locality.—Teopisca, Chiapas, Mexico (20 miles southeast).

Distribution.—Known only from type locality—probably the highlands of Chiapas and Guatemala.

Characters.—Closely similar in color to *saturatus*, but top and sides of nose whitish, sides of face marked with fuscous, and upper surface of flying membrane more brownish; soles naked; skull essentially like that of *volans*.

Color.—Spring pelage (April specimen, worn on nape and tail only): Upperparts dark sayal brown; sides of face smoke gray, strongly varied with fuscous; eye-ring fuscous; ears flesh color, shaded with fuscous; top and sides of nose creamy white; upper surface of flying membrane clove brown; hind feet fuscous, the toes faintly shaded with buff; front feet buffy white; tail, above, snuff brown; beneath, pinkish cinnamon or pale cinnamon buff; underparts creamy white, irregularly washed with pinkish cinnamon, most strongly along edges of membranes.

Skull.—Essentially the same as that of *volans*—slightly larger than that of *saturatus*.

Measurements.—Type and topotype: Total length, 237, 238; tail vertebræ, 112, 107; hind foot, 30, 31.5. *Skull:* Greatest length, 35.1, 34.9; zygomatic breadth, 21.3, 21.9; mastoidal breadth, 17.8, 17.5; least interorbital breadth, 8.7, 9.2; least postorbital breadth, 8.7, 9.2; length of nasals, 10.3, 9.9; maxillary toothrow, 6.4, 6.3.

Type specimen.—No. 132833, U. S. Nat. Mus. (Biological Survey collection); ♂ ad., skin and skull; collected April 8, 1904, by E. A. Goldman.

Remarks.—This race, although widely separated geographically from the United States forms of the group, bears so close a resemblance to *saturatus* that a subspecific designation seems best to express its relationship. From no point between southern Texas and Chiapas are specimens of the genus known, and Nelson and Goldman in their travels in Mexico heard of flying squirrels in only a few localities. The animals were reported to occur in the Pinal de Amoles range of mountains in eastern Queretaro, but whether these are referable to this race is unknown. Tomes, under the name *Pteromys volucella*, records a specimen from Duenas, Guatemala, which undoubtedly is referable to the present form.[1]

Specimens examined.—Two, from type locality.

Glaucomys sabrinus Group.

GLAUCOMYS SABRINUS (SHAW).

[Synonymy under subspecies.]

General characters.—Size medium to large (hind foot 34 mm. or more); hairs on underparts plumbeous at roots.

Cranial characters.—Skull medium to large (greatest length 36 mm. or more); rostrum usually rather long (except in *macrotis*); audital bullæ moderately or in some races considerably inflated.

Color.—Upperparts cinnamon, pinkish cinnamon, vinaceous-cinnamon, vinaceous-fawn, cinnamon-buff, avellaneous, drab, cinnamon-drab, wood brown, sayal brown, snuff brown, mikado brown, or pecan brown; sides (and in some races front) of face smoke gray or pale gray, often washed with buff, cinnamon, or fuscous; eye-ring fuscous; borders of flying membrane above, clove brown, fuscous, or blackish

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[1] Tomes, Robert F., Proc. Zool. Soc. London, 1861, p. 281.

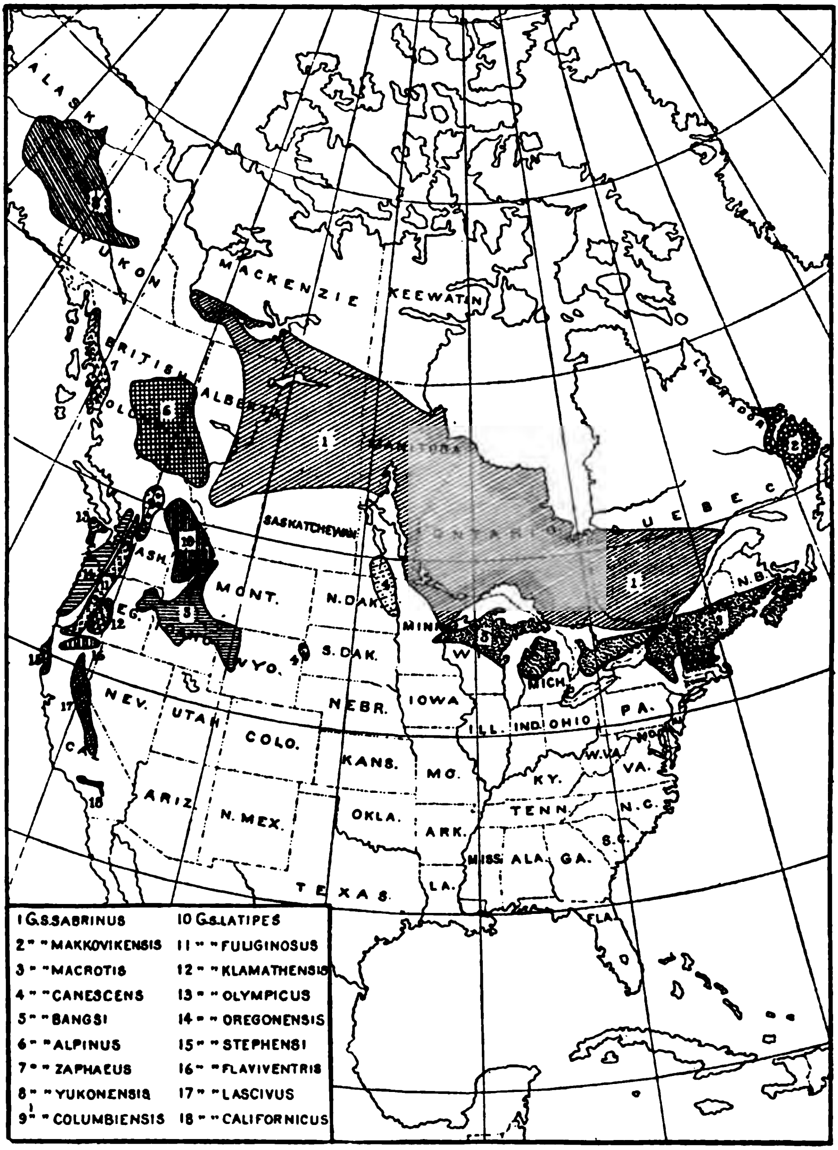

Fig. 3.—Map showing the distribution of the subspecies of *Glaucomys sabrinus* (except *G. s. bullatus*, see fig. 4, p. 51). based on specimens examined.

brown; forefeet hair-brown, wood brown, drab, or mouse gray; hind feet hair-brown, fuscous, clove brown, wood brown, snuff brown, or mouse gray, the soles buffy white, yellowish white, creamy white, drab, mouse gray, cinnamon-buff, colonial buff, olive-ochre, olive-buff, or oil yellow; tail above, cinnamon, hair-brown, wood brown, sayal brown, snuff brown, clove brown, fuscous, or fuscous-black, usually darkest at the tip; tail beneath, pinkish cinnamon, vinaceous-cinnamon, pinkish-, ochraceous-, cinnamon-, colonial-, cream-, or olive-buff, drab, drab-gray, wood brown, avellaneous, clove brown, or fuscous-black, frequently edged with hair-brown or fuscous; underparts white, creamy white, or buffy white, more or less washed or clouded with pinkish cinnamon, pinkish-, ochraceous-, cream-, cinnamon-, colonial-, or cartridge-buff, straw yellow, greenish yellow, Naples yellow, wood brown, or avellaneous.

Geographic distribution.—Wooded parts of Alaska, Canada, northeastern United States, and mountains of western United States, from the Yukon Valley, Cook Inlet, Upper Mackenzie River, Fort Anderson, Great Slave Lake, northern Manitoba, northern Quebec (Hamilton River), and Labrador (Makkovik), south to northern Massachusetts, southern New York (Catskill Mountains), Pennsylvania (Erie ?), central Michigan (Montcalm County), northern Wisconsin, central Minnesota (Elk River), South Dakota (Black Hills), Utah (Uinta[1] and Wasatch Mountains[2]), Idaho (Sawtooth Mountains), and southern California (Sierra Nevada, San Bernardino, and San Jacinto Mountains) (figs. 3 and 4).

GLAUCOMYS SABRINUS SABRINUS (SHAW).

HUDSON BAY FLYING SQUIRREL.

[Pl. II, fig. 11; Pl. IV, fig. 11; Pl. VI, fig. 6; Pl. VII, fig. 10.]

Sciurus hudsonius Gmelin, Syst. Nat., I, p. 153, 1788 (not *Sciurus vulgaris hudsonicus* Erxleben, 1777).

Sciurus sabrinus Shaw, Gen. Zool., II, p. 157, 1801.

? *Pteromys canadensis* Geoffroy, Cat. Mamm. Mus. Hist. Nat., Paris, p. 170, 1803. Type locality, North America [probably Quebec, Canada.[3]]

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[1] Allen (Monogr. North Amer. Rodentia, p. 664, 1877) records a specimen from Uinta Mountains which has since disappeared from the collection; this specimen was taken September 20, 1870, by H. D. Schmidt, near the head of Smiths Fork, Utah (see Prelim. Rept. U. S. Geol. Surv. Wyoming, etc., pp. 41–44, 461, 1871).

[2] F. E. Crandall, of Victor, Idaho, states that while living in Emery County, Utah, he often saw flying squirrels and knew of their being killed by loggers when felling trees. His report indicates that some form of the group ranges much farther south than has been supposed.

[3] The description under this name was based on a specimen (No. CCCLI) in the Paris Museum, but as I am informed by Dr. A. Menegaux in a recent letter, this specimen is not now in the museum. The description is inadequate, but the size of the animal is given as 150 mm. This measurement probably refers to the length of head and body, and if so agrees well with that of certain specimens of *sabrinus* from southern Ontario. It is too large for any member of the *volans* group. The specimen doubtless was sent from Canada (probably from the vicinity of Quebec), as suggested by the common name, "Le Polatouche du Canada," and the name *canadensis* may thus be considered a synonym of *sabrinus* of two years earlier date.

Pteromys sabrinus Richardson, Zool. Journal, III, p. 519, 1828; Fauna Boreali-Amer., I, p. 193, 1829; Audubon and Bachman, Quad. North Amer., III, p. 202, 1853, plate CXLIII.

Pteromys hudsonius Fischer, Synop. Mamm., p. 365, 1829; Baird, Mamm. North Amer.: Rept. Expl. and Surv. R. R. Pac., VIII, p. 288, 1857.

Sciuropterus volucella var. *hudsonius* Allen, Proc. Boston Soc. Nat. Hist., XVI, p. 289, 1874; Allen, Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr., XI, p. 655, 1877.

Sciuropterus volucella sabrinus Rhoads, Amer. Nat., XXVIII, p. 525, 1894.

Sciuropterus sabrinus Bangs, Proc. Biol. Soc. Washington, X, p. 162, 1896.

Type locality.—Mouth of Severn River, Ontario, Canada.

Distribution.—Interior of Canada, from Fort Simpson (possibly Fort Anderson), Mackenzie, and lower Churchill River, west side of Hudson Bay, south to northern Minnesota, extreme northwestern Wisconsin, southern Ontario (vicinity of Lake Nipissing), and southern Quebec (Lake Edward).

Characters.—Size medium (for the group); general tone of upperparts vinaceous-cinnamon; sides of face smoke gray; tail strongly shaded with fuscous; underparts whitish, shaded with drab; skull of medium size, rather long and narrow, with narrow braincase.

Color.—*Winter pelage:* Upperparts deep vinaceous-cinnamon, the sides faintly washed with light pinkish cinnamon, the underfur dark mouse gray; upper surface of flying membrane fuscous, the color extending over legs and becoming paler on feet; toes shaded with grayish white; front and sides of face smoke gray or pale smoke gray; eye-ring fuscous; underparts soiled whitish, faintly washed with pale yellowish and more or less strongly shaded with drab or hair-brown, especially along sides, the underfur deep neutral gray; tail, above, hair-brown or fuscous, often shaded near the base with vinaceous-cinnamon, the tip usually clear fuscous; beneath, drab, shaded with pale wood brown and bordered on sides and tip with hair-brown or fuscous; soles buffy white on inner side, drab on outer side. *Summer pelage:* Similar to the winter pelage.

Skull.—Size medium (larger than *macrotis*, smaller than *alpinus*); braincase rather narrow and elongate; zygomata not widely expanded, contracted anteriorly; dorsal outline nearly straight from nasals to postfrontal region; braincase moderately depressed; audital bullæ of medium size.

Measurements.—Adult male from Cochrane, Ontario: Total length, 315; tail vertebræ, 140; hind foot (dry), 40; ear from notch (dry), 18. Adult female from Lake Edward, Quebec: 315; 148; 43; 20.5. Average of 4 adults from Norway House, Manitoba: Hind foot (dry), 39.5 (38.5–41). *Skull:* Subadult male from Cochrane, Ontario: Greatest length, 40; zygomatic breadth, 24; mastoidal breadth, 18.1; least interorbital breadth, 7.3; least postorbital breadth, 8.9; length of nasals, 11.5; maxillary toothrow, 7.8. Two adults from vicinity of Great Slave Lake, Mackenzie: Greatest length, 39.9, 40.2; zygomatic breadth, 24.5, 24.4; mastoidal breadth, 18.8, 19.2; least interorbital breadth, 8.3, 8.2; least postorbital breadth, 9.4, 9.2; length of nasals, 12, 12.8; maxillary toothrow, 7.8, 8.1.

Type specimen.—Not now known to exist.[1]

Remarks.—The Hudson Bay flying squirrel—the first form of the group to receive a name—is still imperfectly known, no specimens from the type locality being as yet available. A good series of skins from Norway House, Manitoba, doubtless represent the typical form, and these have been used in making comparisons, but there are no skulls in any collection from nearer the type locality than Great Slave Lake on one side and Cochrane, Ontario, on the other. Since these skulls, however, agree essentially in characters, they are assumed to be typical. Two winter specimens from Cochrane, Ontario, differ from Norway House specimens in being slightly paler and less vinaceous above, having the hind feet mouse gray and the tail dark hair-brown, with scarcely a trace of vinaceous; whether these specimens represent the typical race or an unrecognized form can not now be decided.

The present race has a very wide range and apparently intergrades with all the surrounding forms—with *makkovikensis* in eastern Quebec, with *macrotis* in northern Minnesota, northern Wisconsin, northern Michigan, and southern Ontario; with *canescens* in southern Manitoba, with *alpinus* in southern Mackenzie and Alberta, and probably with *bangsi* in southwestern Alberta and northwestern Montana. Specimens showing intergradation with *alpinus* have been examined from Fort Providence and Fort Simpson, Mackenzie; and from Cascade Rapid, Grand Rapids, Edmonton, and Red Deer, Alberta. The northern specimens differ from typical *sabrinus* in being paler and grayer;[2] those from Red Deer are nearly typical in color, but have skulls closely resembling those of *alpinus*. Specimens from Trout Creek, Ontario; Hinckley and Itasca County, Minn.; and Gordon, Wis., are intermediate between *sabrinus* and *macrotis*. A specimen from Godbout, Quebec, agrees with *sabrinus* in color, but has a skull equaling that of *makkovikensis* in size. Specimens from Rat Portage, Ontario, and Winnipeg, Manitoba, are paler than the typical form, thus showing approach to *canescens*.

A specimen in worn and faded pelage, without tail or skull, from Fort Liard, Mackenzie, is provisionally referred to this race. Better material from that region may show the form occurring there to be *alpinus*.

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[1] The names *hudsonius* and *sabrinus* were based on Forster's account (Philos. Trans., LXII, p. 379, 1772) of a specimen sent to the Royal Society from the mouth of Severn River.

[2] Some of these intermediates bear a surprisingly close resemblance in color to *bangsi*.

Specimens examined.—Total number, 72, as follows:

- **Alberta:** Calgary, 1; Cascade Rapid, Athabaska River, 1; Didsbury, 1; Edmonton, 4;[1] Grand Rapids, Athabaska River, 1; Gull Lake, 1;[2] Red Deer, 2.[3]
- **Mackenzie:** Big Island, Great Slave Lake, 3; Fort Anderson, 1;[3] Fort Liard, 1;[4] Fort Providence, 5;[5] Fort Resolution, 1;[6] Fort Simpson, 2; Hay River, Great Slave Lake, 2.
- **Manitoba:** "Hudson Bay," 1; Norway House, 9; Oxford House, 1; Red River Settlement, 3; Selkirk Settlement, 1; Winnipeg, 2.
- **Minnesota:** Hinckley, 2; Itasca County, 8.[7]
- **Ontario:** Cochrane, 2;[6, 9] Hannah Bay (near Moose Factory), 1;[2] Matawagamingue [=Ft. Mattagami], 5; Moose Factory, 1;[2] Rat Portage, 1; Trout Creek, 2.[8]
- **Quebec:** Godbout, 2; Lake Edward, 1;[10] Tadousac, 1.[6]
- **Saskatchewan:** Cumberland House, 1.
- **Wisconsin:** Gordon, 1;[7] Nemakagan River, Burnett County, 1.[11]

GLAUCOMYS SABRINUS MAKKOVIKENSIS (SORNBORGER).

LABRADOR FLYING SQUIRREL.

[Pl. II, fig. 12; Pl. IV, fig. 12.]

Sciuropterus sabrinus makkovikensis Sornborger, Ottawa Nat., XIV, p. 48, June 6, 1900.

Type locality.—Makkovik, Labrador.

Distribution.—Coast region of Labrador and eastern Quebec; exact limits unknown.

Characters.—Similar to *sabrinus*, but larger and darker, with darker face, tail, and feet.

Color.—*Adults:* Upperparts dark vinaceous-cinnamon (averaging a shade darker than in *sabrinus*); sides of face smoke gray; upper surface of flying membrane clove brown; feet clove brown to fuscous, the soles buffy white and toes washed with the same color; tail fuscous-black or clove brown, both above and below, moderately mixed (chiefly near the base) with pinkish cinnamon; underparts soiled whitish, faintly washed with light pinkish cinnamon or pinkish buff. *Young:* Upperparts wood brown, shaded with vinaceous-cinnamon; tail nearly uniform fuscous-black.

Skull.—Similar to that of *sabrinus*, but slightly larger.

Measurements.—Average of 5 specimens (adult and subadult) from Labrador: Total length, 309 (293–330); tail vertebræ, 138

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[1] Collection Victoria Mem. Mus.

[2] Collection Mus. Comp. Zool.

[3] Fragments of skeleton; provisionally referred.

[4] Provisionally referred.

[5] Three in collection Victoria Mem. Mus.

[6] Collection Amer. Mus. Nat. Hist.

[7] Collection Dr. H. V. Ogden, Milwaukee, Wis.

[8] Collection Carnegie Museum.

[9] Collection W. E. Saunders, London, Ont.

[10] Collection Field. Mus. Nat. Hist.

[11] Collection Milwaukee Pub. Mus.

(128–146); hind foot, 41.8 (40–45). *Skull:* Average of 6 adults from Labrador: Greatest length, 40.7 (40.4–41.3); zygomatic breadth, 24.5 (23.5–25.2); mastoidal breadth, 18.9 (18.6–19.1); least interorbital breadth, 7.8 (7.3–8.2); least postorbital breadth, 10 (9.7–10.3); length of nasals, 11.4 (10.7–12.2); maxillary toothrow, 7.8 (7.3–8.1).

Type specimens.—Cotypes, Nos. 10476, 10477, Mus. Comp. Zool. (formerly Nos. 1540, 1541, collection J. D. Sornborger); skins and skulls, the skulls imperfect; collected in 1899 by Rev. W. W. Perritt.

Remarks.—The Labrador flying squirrel, like certain other species from this region, is larger and darker than the form from the interior of Canada. It is very much larger than *macrotis*, of New England. Intergradation with *sabrinus* apparently takes place in the vicinity of Godbout, Quebec. There is no material to show what form occupies the interior of eastern Quebec.

Specimens examined.—Total number, 15, as follows:

Labrador: Cartwright, 1; L'Anse au Loup, 1;[1] Makkovik, 9;[1] Paradise, 3.
Quebec: Northwest River, 1.

GLAUCOMYS SABRINUS MACROTIS (MEARNS).

MEARNS FLYING SQUIRREL.

[Pl. II, fig. 10; Pl. IV, fig. 10; Pl. VI, fig. 5.]

Sciuropterus volucella hudsonius Merriam, Trans. Linn. Soc. New York, II, p. 108, 1884 (not *Sciurus hudsonius* Gmelin).

Sciuropterus sabrinus macrotis Mearns, Proc. U. S. Nat. Mus., XXI, p. 353, Nov. 4, 1898.

Type locality.—Hunter Mountain (Catskills), Greene County, New York; altitude 3,300 feet.

Distribution.—Nova Scotia, New Brunswick, Maine, New Hampshire, Vermont, northern Massachusetts, Boreal portions of New York, northern Pennsylvania (?), southern Ontario, northern part of Michigan, and northeastern Wisconsin; west to Elk River, Minnesota.

Characters.—Similar to *sabrinus*, but smaller; ears averaging slightly longer; upperparts and hind feet paler and underparts whiter.

Color.—*Winter pelage* (adult): Upperparts cinnamon or pinkish cinnamon (rarely light pinkish cinnamon), shading on sides to pinkish buff; sides of face pale smoke gray, this color extending back on sides of neck beyond the ears; top of nose frequently tinged with gray; upper surface of membranes clove brown; fore feet drab, clouded with dull white; hind feet, above, light hair-brown or mouse gray; beneath, soiled whitish, shaded with drab or buff; tail, above, dull cinnamon, more or less mixed with hair-brown or fuscous, the general tone varying from hair-brown to pale snuff brown; beneath, pinkish cinnamon or light pinkish cinnamon; underparts white, irregularly shaded with light pinkish cinnamon. *Summer pelage:* Similar to the winter pelage, but upperparts usually slightly darker—pale orange-cinnamon. *Young* (October): Upperparts between wood brown and fawn color, otherwise as in adult.

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[1] Collection Mus. Comp. Zool.

Skull.—Similar to that of *sabrinus*, but decidedly smaller; braincase less elongate, more nearly spherical. Compared with *G. volans volans:* Slightly larger (greatest length 36 mm. or more in *macrotis;* 35.6 mm. or less in *volans*); fronto-parietal region more elevated; braincase deeper and less flattened.

Measurements.—Average of 16 adults from New York and New England:[1] Total length, 275.6 (263–290); tail vertebræ, 126.4 (115–135); hind foot, 36 (34–38); ear from notch (dry),[2] 18.8 (16–20). *Skull:* Average of 11 adults from same region: Greatest length, 37.3 (36–38.7); zygomatic breadth, 22.6 (21.9–23.5); mastoidal breadth, 17.6 (17.2–18); least interorbital breadth, 6.9 (6.2–7.3); least postorbital breadth, 9.2 (8.6–9.9); length of nasals, 10.7 (10–11.5); maxillary toothrow, 7 (6.4–7.7).

Type specimen.—No. 83152, U. S. Nat. Mus.; ♀ ad., skin and skull; collected August 31, 1896, by Edgar A. Mearns.

Remarks.—The Mearns flying squirrel is a strongly marked form having a rather extensive range in the Northeastern States and southern Canada, from Minnesota to Nova Scotia. It is not known from any point south of the Catskills in New York and the vicinity of Erie, Pa.,[3] but may be expected to occur in the mountainous parts of Pennsylvania and possibly farther south in the Alleghenies.

Intergradation with *sabrinus* is shown by specimens from southern Ontario (Gooderham) and northern Michigan (Porcupine Mountains and Vermilion). Two specimens from Elk River, Minn., show approach to *canescens*, one of them being almost as pale as that form. The skulls are nearly typical of *macrotis.* Specimens from Maine have somewhat shorter ears than those from New York, Massachusetts, and New Hampshire.

The range of this form overlaps that of *G. volans volans* for a considerable distance in southern New England, New York, Michigan, Wisconsin, and Minnesota. Although some specimens approach *volans* rather closely in size and resemble it in the shape of skull and shortness of rostrum, they are always readily separable (except, perhaps, in the young) from the latter species by the plumbeous bases of the hairs on the belly. The upperparts, also, are decidedly more vinaceous and less drab than in *volans.*

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[1] Hunter Mountain and Peterboro, N. Y.; Wilmington, Mass.; Ossipee, N. H.; Greenville, Bucksport, and Moosehead Lake, Maine.

[2] Seven specimens from New York, Massachusetts, and New Hampshire.

[3] The specimens labeled as from Erie are without further data, but are said to have been in the collection of Geo. B. Sennett; they may not have been collected in the immediate vicinity of Erie. There are no other Pennsylvania records.

Specimens examined.—Total number, 78, as follows:

Maine: Bucksport, 3;[1] Greenville, 8;[1] Lincoln, 6;[2] Moosehead Lake, 1;[1] Steuben, 1; Third Mopang Lake, 2.[2]
Massachusetts: Lunenburg, 1; Wilmington, 3; Winchendon, 1.
Michigan: Le Roy, 1;[3] Montcalm County, 1;[3] Palmer, 1; Porcupine Mountains, 3;[3] Vermilion, 3.[3]
Minnesota: Elk River, 2.
New Brunswick: No specific locality, 1.
New Hampshire: Ossipee, 4.
New York: Adirondack Mountains, 1; Big Moose Lake, 3; Hunter Mountain, Greene County, 1; Locust Grove, 1; Peterboro, 1.
Nova Scotia: Annapolis, 3;[2, 4] Halifax, 3; Kings County, 5.[5]
Ontario: Gooderham, 3;[6] Maganetewan, 1;[2] New Edinburgh, 1;[5] Woodstock, 1.[7]
Pennsylvania: Erie [=mountains near?], 2.[8]
Vermont: Rutland, 2;[9] Sherburne, 1.[9]
Wisconsin: Clarks Lake, Door County, 1; Kelley Brook, 1;[10] Lakewood, 2; Langlade County, 1;[11] Mamie Lake, Vilas County, 2.

GLAUCOMYS SABRINUS CANESCENS Howell.

Pallid Flying Squirrel.

[Pl. II, fig. 7; Pl. IV, fig. 7; Pl. VI, fig. 11.]

Glaucomys sabrinus canescens Howell, Proc. Biol. Soc. Washington, XXVIII, p. 111, May 27, 1915.

Type locality.—Portage la Prairie, Manitoba.

Distribution.—Southern Manitoba; eastern North Dakota; Black Hills, S. Dak.; and Bear Lodge Mountains, Wyo.; exact limits unknown.

Characters.—Similar to *macrotis*, but much paler, with grayer head and larger skull. Compared with *sabrinus:* Size smaller; upperparts and feet paler; underparts whiter.

Color.—*Winter pelage:* Upperparts light pinkish cinnamon, shading to pale pinkish cinnamon on sides; front and sides of face (sometimes nearly the whole head) pale smoke gray; ears pale fuscous; eye-ring and upper side of flying membrane fuscous; feet hair-brown, the toes marked with grayish white; tail, above, dark cinnamon, shaded with hair-brown; beneath, light pinkish cinnamon, edged with hair-brown; underparts and soles creamy white.

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[1] Collection Mus. Comp. Zool.
[2] Collection Acad. Nat. Sci. Philadelphia.
[3] Collection Univ. Michigan.
[4] Collection E. R. Warren, Colorado Springs, Colo.
[5] Collection Victoria Mem. Mus.
[6] Collection Field Mus. Nat. Hist.
[7] Collection W. E. Saunders, London, Ont.
[8] Collection Amer. Mus. Nat. Hist.
[9] Collection G. L. Kirk, Rutland, Vt.
[10] Collection Milwaukee Pub. Mus.
[11] Collection Dr. H. V. Ogden, Milwaukee, Wis.

Skull.—Similar to that of *macrotis*, but slightly longer and relatively narrower, with longer nasals; decidedly smaller than that of *sabrinus*.

Measurements.—Average of 3 adults:[1] Total length, 297 (290–306); tail vertebræ, 138 (133–146); hind foot, 37.7 (37–38). *Skull:* Two topotypes (adult): Greatest length, 38.5, 38.8; zygomatic breadth, 22.8, 22.9; mastoidal breadth, 17.5, 17.6; least interorbital breadth, 9.2, 9.5; least postorbital breadth, 9.4, 9.2; length of nasals, 11.5, 11.2; maxillary toothrow, 7.7, 7.6.

Type specimen.—No. 7663, Field Mus. Nat. Hist.; ♀ subad., skin and skull; collected February 3, 1900, by G. F. Dippie.

Remarks.—This is the palest of the races of *sabrinus*, occupying chiefly the thinly timbered parts of southern Manitoba and eastern North Dakota. The limits of its range are not known, and may extend westward to Saskatchewan. Two specimens from the Bear Lodge Mountains, Wyo., are referred to this race, but a larger series may show characters to separate the form in that region. These two specimens show some approach to *bangsi* in skull characters and in a slightly more vinaceous coloring on the upperparts. One of them has a wash of pinkish cinnamon on the underparts. In a specimen from Portland, N. Dak., the upperparts are a deeper shade of pinkish cinnamon and the skull is larger, showing, apparently, intergradation with *sabrinus*. Two specimens in worn pelage from Pembina, N. Dak., are also considered intermediate between *canescens* and *sabrinus*.

Specimens examined.—Total number, 10, as follows:

Manitoba: Carberry, 1; Portage la Prairie, 2.[2]
Minnesota: Breckenridge, 1.
North Dakota: Grafton, 1; Pembina, 2; Portland, 1.
Wyoming: Bear Lodge Mountains (Middle Fork Hay Creek), 2.

GLAUCOMYS SABRINUS BANGSI (RHOADS).

BANGS FLYING SQUIRREL.

[Pl. II, fig. 3; Pl. IV, fig. 3; Pl. VI, fig. 10.]

Sciuropterus alpinus bangsi Rhoads, Proc. Acad. Nat. Sci. Philadelphia, June, 1897, p. 321.

Type locality.—Idaho County, Idaho.

Distribution.—Mountains of central Idaho, eastern Oregon, southwestern Montana, and western Wyoming, north to vicinity of Flathead Lake, Montana; southern limits unknown.

Characters.—Similar in size and color to *sabrinus*, but upperparts averaging more drab (less vinaceous or ochraceous) and underparts more clouded with pinkish cinnamon (never yellowish white, as in

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[1] Two from type locality; one from Portland, N. Dak.
[2] Collection Field Mus. Nat. Hist.

sabrinus); feet grayer (less brownish). Compared with *alpinus:* Upperparts decidedly more vinaceous, tail paler and much less clouded with fuscous.

Color.—Winter pelage: Upperparts pale wood brown or avellaneous, shading in some specimens to vinaceous-cinnamon; feet pale hair-brown, shading to drab-gray, the toes often grayish white; tail above, wood brown, tinged with cinnamon and more or less shaded with hair-brown or fuscous; beneath, light pinkish cinnamon, shaded with dark hair-brown; underparts whitish, strongly washed with pinkish cinnamon or avellaneous. *Variation* (May specimen from Lake Como, Mont.): Upperparts pale orange-cinnamon; feet pale fuscous.

Skull.—Very similar to that of *sabrinus;* slightly smaller than that of *alpinus*, with smaller bullæ.

Measurements.—Average of 6 (adult and subadult) from Idaho and Montana:[1] Total length, 315 (304–327); tail vertebræ, 142 (137–148); hind foot, 39.5 (37–41). *Skull:* Average of 7 (adult and subadult) from same localities: Greatest length, 39.9 (38.2–41.2); zygomatic breadth, 24.3 (23.3–25); mastoidal breadth, 18.7 (18.3–19.1); least interorbital breadth, 7.5 (6.9–8); least postorbital breadth, 9 (8.4–9.7); length of nasals, 12.2 (11.1–12.5); maxillary toothrow, 8.1 (7.6–8.7).

Type specimen.—No. 6959, Mus. Comp. Zool. (formerly same number, collection E. A. and O. Bangs); ♂ subad., skin and skull; collected March 8, 1897, by Harbison and Bargamin, Raymond, Idaho.

Remarks.—This subspecies is the smallest of the Rocky Mountain forms of *sabrinus*. It agrees with the typical race in skull characters, but shows some approach in color to *alpinus*, differing from the latter, however, in color of tail and skull characters. Intergradation with *sabrinus* is indicated by a specimen from Paola, Mont. With *latipes*, whose range meets (and possibly overlaps) that of *bangsi*, there seems to be no intergradation. The specimen from Paola shows no approach to *latipes*, while one from Nyack, a few miles farther north, is clearly referable to the latter form. Specimens from western Wyoming (Pahaska, Kendall, Pacific Creek) are slightly larger than typical specimens, but do not differ appreciably in color. An August specimen from Anthony, Oreg., provisionally referred to this race, has the upperparts rich orange-cinnamon, much darker than any of the Idaho series, and quite different from another August specimen from Bourne, Oreg., which is in the normal wood-brown phase.

Specimens examined.—Total number, 31, as follows:

Idaho: Idaho County, 2;[2] Ketchum, 2;[2] Sawtooth Lake, 2.

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[1] Idaho County (type and topotype), Ketchum, and Sawtooth Lake, Idaho; Florence, Mont.

[2] Collection Mus. Comp. Zool.

Montana: Florence, 6; Paola, 1; Rock Creek, near Lake Como, 1.
Oregon: Anthony, 9;[1] Bourne, 1.
Wyoming: Kendall (12 miles north, at 7,700 feet altitude), 2; Pacific Creek, 1; Pahaska, 2; Wind River Mountains, near Dubois, 2.

GLAUCOMYS SABRINUS ALPINUS (RICHARDSON).

RICHARDSON FLYING SQUIRREL.

[Pl. II, fig. 4; Pl. IV, fig. 4; Pl. VI, fig. 12.]

Pteromys alpinus Richardson, Zool. Journal, III, p. 519, 1828; Audubon and Bachman, Quad. North Amer., III, p. 206, 1854; Baird, Mamm. North Amer.: Rept. Expl. and Surv., R. R. Pac., VIII, p. 289, 1857.

Pteromys sabrinus var. *β alpinus* Richardson, Fauna Boreali-Amer., I, p. 195, 1829.

[*Sciuropterus volucella*] *alpinus* Trouessart, Bull. Soc. Angers, X, p. 67, 1880.

Sciuropterus alpinus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, p. 319, 1897.

Type locality.—Jasper House, Alberta.[2]

Distribution.—Rocky Mountain region of Alberta and British Columbia, from vicinity of Henry House north at least to Peace River and Babine Lake, British Columbia (limits of range unknown).

Characters.—Similar to *sabrinus*, but upperparts much grayer (less vinaceous), tail darker, and skull larger, with broader braincase.

Color.—*Winter pelage:* Upperparts light drab; sides of face pale smoke gray; eye-ring fuscous; ears edged with blackish brown; upper surface of flying membrane blackish brown; hind feet hair-brown; fore feet similar but slightly paler; soles and palms soiled whitish; tail wood brown, much mixed, both above and below, with fuscous or clove brown, strongest on sides and tip; underparts soiled whitish, sometimes irregularly marked (chiefly along median line) with light pinkish cinnamon.

Skull.—Similar to that of *sabrinus*, but larger, with broader braincase; postorbital constriction relatively narrow.

Measurements.—Two adults from Henry House, Alberta: Total length, 292, 343; tail vertebræ, 123, 155; hind foot, 44.5, 43; average of 3 adults from Stuart Lake, B. C.: 322; 149; 41.7. *Skull:* Average of 3 adults from Henry House and Jasper House, Alberta: Greatest length, 41.5 (41.2–42); zygomatic breadth, 25.4 (25.1–25.6); mastoidal breadth, 19.4; least interorbital breadth, 8.3 (8.2–8.8); least postorbital breadth, 9.2 (9.1–9.6); length of nasals, 12.5 (12.4–12.6); maxillary toothrow, 7.8 (7.5–8.1).

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[1] Seven in collection Amer. Mus. Nat. Hist.; two in Mus. Vert. Zool., Univ. California.

[2] The habitat is given by Richardson in the original description as "Vallies in the Rocky Mountains." Later (Fauna Boreali-Amer., I, p. 195, 1829) he speaks of specimens from the head of the Elk [=Athabaska] River, and from the south branch of the Mackenzie [=Liard, specimens probably from Fort Nelson]. As Richardson speaks of Drummond as the discoverer of the species, the vicinity of Jasper House, on the headwaters of the Athabaska, near which place Drummond made extensive collections, may be considered the type locality.

Type specimen.—None known to exist.

Remarks.—This handsome race, recognized as distinct by Richardson nearly a century ago, has until recently been imperfectly known. Baird, in 1857, admitted the species but was in doubt as to its real characters. Allen, in his Monograph of the Sciuridæ (1877) placed it in synonymy. Rhoads, in 1897,[1] restored it to specific rank, evidently using New England specimens of *macrotis* in comparison and considering them typical of *sabrinus*. Additional material now available, both of typical *alpinus* and of *sabrinus* from various parts of its range, shows conclusively that the two forms are subspecifically related. As already shown under *sabrinus* (p. 33), specimens from western Mackenzie and northern Alberta are intermediate in color between *alpinus* and *sabrinus* and those from southern Alberta have skulls nearly typical of *alpinus* but agree with *sabrinus* in color. Of two specimens from Peace River Canyon, B. C., one is typical of *alpinus*, while the other closely matches *sabrinus* in color. The present form intergrades, also, with *zaphæus* and *columbiensis* in British Columbia, and possibly with *bangsi* in southern Alberta. Several specimens from Stuart Lake, B. C., are intermediate in color between *alpinus* and *columbiensis*, while one specimen is so dark as to suggest intergradation with *zaphæus*.

Specimens examined.—Total number, 23, as follows:

Alberta: Henry House, 3; Jasper House, 2; no specific locality, 1.[2]
British Columbia: Babine Lake, 8; Cariboo, 1;[2] Peace River Canyon (near Hudsons Hope), 2; Stuart Lake, 6.[3]

GLAUCOMYS SABRINUS YUKONENSIS (Osgood).

Yukon Flying Squirrel.

[Pl. II, fig. 8; Pl. IV, fig. 8.]

Sciuropterus yukonensis Osgood, North Amer. Fauna No. 19, p. 25, Oct. 6, 1900.

Type locality.—Camp Davidson, Yukon River, Yukon (near Alaska-Canada boundary).

Distribution.—Yukon River region, from vicinity of Mayo Lake, Yukon (head of Stewart River), to Tanana, Alaska; exact limits unknown.

Characters.—Similar to *sabrinus* in color, but larger, with longer tail, broader hind foot, and larger skull. Compared with *alpinus:* Upperparts more ochraceous (less drab); tail longer and more vinaceous.

Color.—Upperparts pinkish cinnamon to vinaceous-cinnamon; sides of face pale smoke gray, sometimes clouded with light pinkish cinnamon; eye-ring clove brown or fuscous-black; upper surface of flying membrane clove brown or fuscous; legs similar, partially overlaid with the color of the back; feet wood brown, hair-brown, or mouse gray; soles and palms cinnamon-buff or whitish, clouded with mouse gray; tail above, sayal brown, shaded with fuscous, becoming pure fuscous at the tip; beneath, vinaceous-cinnamon or light pinkish cinnamon, edged with fuscous or hair-brown; underparts soiled whitish, moderately washed with light pinkish cinnamon or avellaneous.

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[1] Proc. Acad. Nat. Sci. Philadelphia., 1897, p. 319.

[2] Collection Field Mus. Nat. Hist.

[3] Two in collection Provincial Mus., Victoria, B. C.; one in Acad. Nat. Sci. Philadelphia.

Skull.—Closely similar to that of *alpinus;* braincase slightly larger; nasals slightly shorter.

Measurements.—Type: Total length, 365; tail vertebræ, 180;[1] hind foot (dry), 41; ♀ adult from Tanana, Alaska: 324; 150; 42. *Skull:* Average of 3 adults from Alaska:[2] Greatest length, 41.3 (41–41.5); zygomatic breadth, 25.2 (25.1–25.3); mastoidal breadth, 19.6 (19.5–19.7); least interorbital breadth, 8.1 (7.8–8.3); least postorbital breadth, 9.5 (9.3–10.3); length of nasals, 11.9 (11.6–12.1); maxillary toothrow, 8.3 (7.9–8.7).

Type specimen.—No. $\frac{18898}{35320}$, U. S. Nat. Mus.; ♀ ad., skin and skull; collected December 8, 1890, by R. E. Carson.

Remarks.—This is one of the larger members of the group, about equaling *latipes* and *bullatus* in external measurements. The hind feet, although about the same length as those of *alpinus*, are considerably broader and heavier, and the tail averages longer. Although the present form resembles *sabrinus* in color, its skull is practically identical with that of *alpinus*. No specimens are available from the large area between the known ranges of *alpinus* and *yukonensis*, but in view of the close relationship of these two forms, as shown by the skull characters, it seems probable that they will be found to intergrade, and for that reason *yukonensis* is here treated as a subspecies of *sabrinus*. Osgood states[3] that flying squirrels have been taken in the Knik district, Cook Inlet, but until specimens can be secured from that region their subspecific identity must remain in doubt.

Specimens examined.—Total number, 10, as follows:

Alaska: Big Chena River (65 miles from mouth), 1;[4] Chicken, 1; Tanana, 3; Toklat River (head), 1.

Yukon: Camp Davidson (near Alaska-Canada boundary), 2; Fortymile, 1;[5] Mayo Lake, 1.[6]

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[1] In a topotype, the tail (measured from dry skin) is approximately 160.

[2] Camp Davidson, Tanana, and head of Toklat River.

[3] Osgood, W. H., North Amer. Fauna No. 21, p. 63, 1901.

[4] Skull only.

[5] Collection Mus. Vert. Zool., Univ. California.

[6] Collection Victoria Mem. Mus.

GLAUCOMYS SABRINUS ZAPHÆUS (OSGOOD).

ALASKA COAST FLYING SQUIRREL.

[Pl. III, fig. 6; Pl. V, fig. 6; Pl. VI, fig. 9.]

Sciuropterus alpinus zaphæus Osgood, Proc. Biol. Soc. Washington, XVIII, p. 133, Apr. 18, 1905.

Type locality.—Helm Bay, Cleveland Peninsula, Alaska.

Distribution.—Coast region of southeastern Alaska and northern British Columbia; limits of range unknown.

Characters.—Similar to *alpinus*, but upperparts browner (less grayish) and underparts darker. Compared with *oregonensis*: Upperparts paler; underparts grayer (without cinnamon or buff).

Color.—*Winter pelage:* Upperparts sayal brown; sides of face pale smoke gray, often clouded with fuscous-black, the blackish eye-ring often pronounced; upper surface of flying membrane fuscous; feet dark hair-brown or fuscous, the soles whitish tinged with hair-brown on outer margin; tail above, fuscous, tinged with sayal brown; beneath, dull vinaceous-cinnamon, much clouded with fuscous on sides and tip; underparts soiled whitish, strongly washed with avellaneous or wood brown, strongest along sides. *Summer pelage:* Upperparts yellowish wood brown; underparts washed with pinkish cinnamon.

Skull.—Similar to that of *alpinus*, but braincase narrower, bullæ slightly smaller, and upper toothrow slightly longer.

Measurements.—Average of 6 topotypes (adult): Total length, 307 (292–311); tail vertebræ, 144 (133–152); hind foot (dry skin), 40.7 (39–42); average of 3 topotypes (adult):[1] 306; 145; 40. *Skull:* Average of 6 topotypes (adult and subadult): Greatest length, 40.1 (39.3–41.5); zygomatic breadth, 24.7 (23.7–26.2); mastoidal breadth, 18.7 (18.2–19.1); least interorbital breadth, 7.8 (7.4–8.3); least postorbital breadth, 9 (8.7–9.8); length of nasals, 12.5 (12.2–12.9); maxillary toothrow, 7.8 (8–8.6).

Type specimen.—No. 136137, U. S. Nat. Mus. (Biological Survey collection); ♀ ad., skin and skull; collected January 21, 1905, by Cyrus Catt.

Remarks.—This subspecies is intermediate in color between *alpinus* and *oregonensis*, being nearer the latter in the color of the upperparts, but lacking the deep cinnamon-buff on the underparts. In skull characters it is close to *alpinus* and intergrades with it in the interior of British Columbia. The northern and southern limits of its range are unknown, but very probably it intergrades with *oregonensis* in southwestern British Columbia and possibly with *yukonensis* in Yukon.

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[1] Measured in flesh by Frank Stephens.

Specimens examined.—Total number, 14, as follows:

Alaska: Bradfield Canal, 1;[1] Etolin Island, 1;[1] Helm Bay, Cleveland Peninsula, 10;[2] Tongass, 1.
British Columbia: Nass River, 1.

GLAUCOMYS SABRINUS OREGONENSIS (BACHMAN).

BACHMAN FLYING SQUIRREL.

[Pl. III, fig. 11; Pl. V, fig. 11; Pl. VI, fig. 8.]

Pteromys oregonensis Bachman, Journ. Acad. Nat. Sci. Philadelphia, VIII, p. 101, 1839; Audubon and Bachman, Quad. North Amer., I, p. 132, 1846.
[*Sciuropterus volucella*] *oregonentis* [sic] Trouessart, Bull. Soc. Angers, X, p. 67, 1880.
Sciuropterus alpinus oregonensis Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1897, p. 324.

Type locality.—"Pine woods of the Columbia near the sea"—probably near the present site of St. Helens, Oregon.

Distribution.—Coast region of Oregon, Washington, and southern British Columbia; northern and southern limits unknown.

Characters.—Similar to *zaphæus*, but colors more rufescent, both above and below (upperparts rich reddish brown, underparts cinnamon or buff); sides of face more buffy (less grayish); skull slightly smaller.

Color.—*Winter pelage:* Upperparts mikado brown or pecan brown; sides of face smoke gray or grayish white, often much mixed with buff or cinnamon; upper surface of flying membrane clove brown or fuscous; hind feet snuff brown or pale fuscous, the soles pinkish buff shaded with drab; fore feet hair-brown or drab; tail above, snuff brown, shaded on sides and tip with fuscous or clove brown; beneath, cinnamon-buff; underparts heavily washed with pinkish cinnamon or cinnamon-buff.

Skull.—Similar to that of *zaphæus*, but averaging smaller, with the zygomata less widely expanded. Closely similar to that of *fuliginosus*, but averaging slightly smaller.

Measurements.—Average of 4 adults from Oregon:[3] Total length, 300 (294–310); tail vertebræ, 127 (122–138); hind foot, 38.6 (38–40). *Skull:* Average of 8 adults from Oregon:[4] Greatest length, 39.9 (38.5–40.7); zygomatic breadth, 23.7 (23–24.9); mastoidal breadth, 18.3 (17.6–19); least interorbital breadth, 7.9 (7.3–8.8); least postorbital breadth, 8.6 (8.1–9); length of nasals, 12.2 (10.9–12.9); maxillary toothrow, 8.2 (7.9–8.7).

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[1] Collection Mus. Vert. Zool., Univ. California.
[2] Four in collection Mus. Vert. Zool., Univ. California.
[3] Portland, Yaquina Bay, and Gold Beach.
[4] Portland (3), Latourelle Falls, Yaquina Bay, Gold-Beach, Salem, and lower Columbia River (type).

Type specimen.—No. 235, Acad. Nat. Sci. Philadelphia; adult, skin and skull; skin (dismounted and skull removed) in fair condition, possibly somewhat faded; skull nearly perfect, but portion of occiput cut away; collected in 1839 by J. K. Townsend.

Remarks.—The Bachman flying squirrel is easily recognized by its rich coloration, rufescent above and buffy below. It occupies the humid northwest coast belt, but does not range high in the mountains. Intergradation with *fuliginosus* is shown by a specimen from Marmot, Oreg. (west slope of Mount Hood), and with *columbiensis* by specimens from Sumas, Chilliwack, and Stave Lake, B. C. These latter specimens agree with *oregonensis* in the color of the upperparts, but are much paler beneath. A specimen from Sulphur Springs, Oreg., is considerably paler above than typical specimens. Specimens from Yaquina Bay and Gold Beach, Oreg., have smaller skulls than the type and other specimens from the Columbia River.

Specimens examined.—Total number, 41, as follows:

British Columbia: Agassiz, 1;[1] Chilliwack, 1; Harrison, 1;[2] Mission, 1;[3] Stave Lake, 1;[4] Sumas, 3.[4]

Oregon: Brownsville, 1;[5] Clackamas River, 1; "Columbia River," 3;[6] Elk Head, 1; Gold Beach, 1; Latourelle Falls (18 miles east of Portland), 1;[4] Marmot, 1; Portland, 4; Port Orford, 4; Salem, 1;[7] Sulphur Springs, Benton County (near Albany), 1; Yaquina Bay, 1; no specific locality, 2.

Washington: Camp Skagit, 1; Fort Bellingham, 1; "Lewis River," 1;[4] Olympic Mountains (north Fork Skokomish River), 1; Puget Sound, 6; no specific locality, 1.

GLAUCOMYS SABRINUS COLUMBIENSIS Howell.

Okanagan Flying Squirrel.

[Pl. III, fig. 7; Pl. V, fig. 7; Pl. VI, fig. 7.]

Glaucomys sabrinus columbiensis Howell, Proc. Biol. Soc. Washington, XXVIII, p. 111, May 27, 1915.

Type locality.—Okanogan, British Columbia.

Distribution.—Interior valleys and foothills of southern British Columbia and northern Washington, from Shuswap Lake and Cranbrook, British Columbia, south to Lake Chelan, Washington.

Characters.—Decidedly paler than *oregonensis*, both above and below; similar to *klamathensis*, but upperparts more vinaceous and tail much darker; very similar to *sabrinus*, but soles of hind feet often yellow (as in *klamathensis*), and skull larger. Compared with

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[1] Collection W. E. Saunders, London, Ont.
[2] Collection Provincial Mus., Victoria, B. C.
[3] Collection Victoria Mem. Mus.
[4] Collection Mus. Comp. Zool.
[5] Collection Leland Stanford, Jr., Univ.
[6] Collection Acad. Nat. Sci. Philadelphia.
[7] Collection Game Dept. Oregon.

fuliginosus: Upperparts more vinaceous (less brownish); underparts paler; tail more brownish.

Color.—Winter pelage: Upperparts between vinaceous-cinnamon and vinaceous-fawn; sides of face smoke gray, shaded with fuscous; front of face sometimes marked with grayish white; upper surface of flying membrane clove brown; feet hair-brown or pale fuscous, the soles deep colonial buff, or sometimes grayish white; tail above, snuff brown, shading to fuscous on sides and tip; beneath, pinkish cinnamon, more or less clouded (often strongly) with fuscous; underparts white, tinged with straw yellow or light pinkish cinnamon.

Skull.—Closely similar to that of *alpinus*, but averaging slightly narrower, with flatter, shallower braincase; similar to that of *oregonensis*, but slightly larger, with shorter toothrow; very similar to that of *fuliginosus*, but averaging relatively broader.

Measurements.—Two topotypes (subadult): Total length, 313; tail vertebræ, 143; hind foot, 42. *Skull:* Average of 7 (adult and subadult) from southern British Columbia.[1] Greatest length, 41.1 (40.3–41.6); zygomatic breadth, 24.5 (23.6–25.2); mastoidal breadth, 19.1 (18.8–19.5); least interorbital breadth, 7.8 (7.3–8.6); least postorbital breadth, 9.1 (8.4–9.7); length of nasals, 12.6 (12–13.3); maxillary toothrow, 7.8 (7.6–8.2).

Type specimen.—No. 94310, U. S. Nat. Mus. (Biological Survey collection); ♂ subad., skin and skull; collected May 9, 1898, by Allan Brooks.

Remarks.—This subspecies, like most of the races inhabiting the dry interior valleys of southern British Columbia, is considerably paler than the coast form (*oregonensis*). Intergradation with the latter is shown by a series of specimens from Sumas and Chilliwack, B. C., and with *fuliginosus* by a series from mouth of Salmon River, B. C. Two specimens in the latter series are referable to the present form, although having somewhat darker underparts. Other specimens, labeled as from the same locality but possibly taken at a higher altitude, agree essentially with *fuliginosus*, to which race they are referred. Intergradation with *alpinus* is shown by specimens from Stuart Lake, B. C. (referred to *alpinus*). One specimen from Cranbrook, B. C., is considerably grayer above than the typical form, thus suggesting intergradation with *latipes*, with which it agrees in all other respects. Another from the same place is typical.

Specimens examined.—Total number, 11, as follows:

British Columbia: Cranbrook, 2; Grand Prairie (22 miles northwest of Okanogan), 1;[2] Okanogan, 2; (Okanogan Falls (Shuttleworth Creek), 1;[3] Penticton, 1;[3] Salmon River (mouth), 2;[3] Vernon, 1.

Washington: Chelan Mountains, 1.[4]

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[1] Okanogan, Vernon, Penticton, Cranbrook, and mouth of Salmon River.

[2] Collection Provincial Mus., Victoria, B. C.

[3] Collection Victoria Mem. Mus.

[4] Collection Amer. Mus. Nat. Hist.

GLAUCOMYS SABRINUS FULIGINOSUS (RHOADS).

CASCADE FLYING SQUIRREL.

[Pl. III, fig. 4; Pl. V, fig. 4; Pl. VII, fig. 7.]

Sciuropterus alpinus fuliginosus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, June, 1897, p. 321.

Type locality.—Cascade Mountains, near Martin Station, Kittitas County, Washington (altitude about 8,000 feet).

Distribution.—Cascade Range, from southern British Columbia south through Washington and Oregon to the Siskiyou Mountains, California.

Characters.—Similar to *columbiensis*, but upperparts more brownish (less vinaceous); underparts darker, and tail paler (less brownish). Compared with *oregonensis:* Colors much less rufescent, especially on upperparts and underside of tail.

Color.—*Winter pelage:* Upperparts pale sayal brown (between sayal brown and wood brown), the sides sometimes faintly washed with pinkish cinnamon; upper surface of flying membrane clove brown; sides of face smoke gray or pale smoke gray, sometimes washed with light buff or pale fuscous; eye-ring fuscous; ears hair-brown; hind feet dark hair-brown (approaching fuscous), the toes marked with buffy white, the soles buffy white or yellowish white, edged with hair-brown; tail above, dark hair-brown, shading to fuscous, sometimes sparingly mixed with dull cinnamon or pinkish cinnamon; beneath, pale ochraceous-buff or light ochraceous-buff, edged on sides with fuscous, the bases of hairs pale smoke gray; underparts pinkish cinnamon or light pinkish cinnamon, the throat often creamy white.

Skull.—Closely similar to that of *columbiensis*, but averaging relatively narrower; similar to that of *oregonensis*, but slightly larger.

Measurements.—Average of 3 topotypes (adult): Total length, 308 (304–317); tail vertebræ, 144 (140–153); hind foot, 40.7 (40–42). *Skull:* Average of 10 (adult and subadult) from Easton and Keechelus Lake, Wash.: Greatest length, 41.4 (40.2–42.5); zygomatic breadth, 24.1 (23.5–24.9); mastoidal breadth, 18.7 (17.9–19.3); least interorbital breadth, 8.3 (7.7–9); least postorbital breadth, 9.1 (8.4–9.6); length of nasals, 12.9 (12.3–13.3); maxillary toothrow, 8.4 (8.2–8.4).

Type specimen.—No. 8058, Acad. Nat. Sci. Philadelphia (formerly No. 1058, collection S. N. Rhoads); ♂ subad., skin and skull; collected in March, 1893, by Allan Rupert.

Remarks.—This subspecies, occupying the Cascade Range in Washington and Oregon, is markedly paler than the coast form (*oregonensis*). It intergrades with the latter on the western slopes of the range, with *klamathensis* on the eastern slopes in Oregon, with *colum-*

biensis in southern British Columbia, and with *flaviventris* in northwestern California.

Specimens from Vida and Belknap Springs, Oreg., have browner backs and paler bellies than the typical series, thus showing approach to *oregonensis.* A specimen from Crater Lake, Oreg., approaches *klamathensis* in having paler and more yellowish underparts. Specimens from the Siskiyou Mountains, Cal., are intermediate between *fuliginosus* and *flaviventris*, agreeing with the former in the color of the upperparts and feet and in skull characters, but having the underparts paler and more yellowish than in typical specimens.

Specimens examined.—Total number, 68, as follows:

British Columbia: Hope, 7;[1, 2] Salmon River (mouth), 6.[3]
California: Preston Peak, 1; Siskiyou Mountains, 5.
Oregon: Belknap Springs, 2; Crater Lake, 1; McKenzie Bridge, 2; Vida, 3.[4]
Washington: Bumping Lake, Yakima County, 1; Cowlitz River, 1; Easton, 18; Keechelus Lake, 14; Martin Station, 3; Potato Hill, 15 miles north of Goldendale, 1; Signal Peak, Yakima Indian Reservation, 3.

GLAUCOMYS SABRINUS LATIPES HOWELL.

BROAD-FOOTED FLYING SQUIRREL.

[Pl. III, fig. 8; Pl. V, fig. 8; Pl. VII, fig. 8.]

Glaucomys sabrinus latipes Howell, Proc. Biol. Soc. Washington, XXVIII, p.112, May 27, 1915.

Type locality.—Glacier, British Columbia.

Distribution.—Selkirk Range, and other ranges in southeastern British Columbia, higher mountains of northern Idaho and northwestern Montana; south to Mullan and Orofino, Idaho.

Characters.—Similar to *fuliginosus* but larger; upperparts averaging darker and grayer; feet larger and darker. Compared with *alpinus* and *bangsi:* Size larger; upperparts more brownish (less drab); underparts darker.

Color.—*Winter pelage:* Upperparts drab, more or less mixed with sayal brown; sides of face smoke gray; ears fuscous; upper surface of flying membrane dark clove brown; hind feet fuscous; fore feet dark hair-brown, the toes shaded with buffy white; tail above, fuscous shaded with sayal brown; beneath, pinkish buff or light ochraceous-buff, more or less mixed with fuscous; underparts light ochraceous-buff or cinnamon-buff. *Summer pelage:* Upperparts chiefly sayal brown with a drab tinge, otherwise as in winter.

Skull.—Similar in general to that of *fuliginosus*, but larger (about equaling that of *bullatus*); longer and relatively narrower than that of *alpinus.*

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[1] Collection Mus. Comp. Zool.
[2] Collection E. R. Warren, Colorado Springs, Colo.
[3] Collection Victoria Mem. Mus.
[4] Two in collection Game Dept. Oregon.

Measurements.—Average of 10 adults:[1] Total length, 342 (315–368); tail vertebræ, 153 (145–161); hind foot, 41.4 (38–44). *Skull:* Average of 7 adults:[1] Greatest length, 42.9 (41.6–44.2); zygomatic breadth, 24.5 (24–25.4); mastoidal breadth, 19.5 (19–20); least interorbital breadth, 8.3 (8–8.8); least postorbital breadth, 8.8 (8–9.1); length of nasals, 13.3 (12.5–14); maxillary toothrow, 8.3 (7.9–9).

Type specimen.—No. 68753, U. S. Nat. Mus. (Biological Survey collection), ♀ ad., skin and skull; collected August 13, 1894, by J. Alden Loring.

Remarks.—This subspecies is one of the largest of the American flying squirrels, nearly equaling *bullatus* in external measurements and size of skull. Although evidently closely related to *fuliginosus* of the Cascades, intermediate specimens are unknown, but are likely to be found when further collecting is done in British Columbia. The present form apparently does not intergrade either with *alpinus* of the northern Rockies or with *bangsi* of the Bitterroot and Sawtooth Ranges in Idaho and Montana. From the latter race, the range of which meets that of *latipes* in northern Montana, this form differs in much larger size and darker colors. The range of *latipes* is apparently confined to the mountains, since another form (*columbiensis*) occurs in the Okanogan Valley and at Cranbrook, B. C. One specimen from the latter locality nearly matches specimens of *latipes* in color of the upperparts, but in other characters agrees with *columbiensis.*

Specimens examined.—Total number, 23, as follows:

British Columbia: Glacier, 1; Schoonover Mountain, near Okanogan (4,000 feet altitude), 2;[2] Shuswap, 1.

Idaho: Coolin, 4; Mullan, 7; Orofino, 1; Priest Lake, 1.

Montana: Nyack 1; Stanton Lake, 5.

GLAUCOMYS SABRINUS OLYMPICUS (ELLIOT).

OLYMPIC FLYING SQUIRREL.

[Pl. III, fig. 10; Pl. V, fig. 10; Pl. VII, fig. 6.]

Sciuropterus alpinus olympicus Elliot, Field Columb. Mus., Publ. 30, Zool. Ser., I, p. 225, Feb. 1, 1899.

Type locality.—Happy Lake, Olympic Mountains, Washington.

Distribution.—Olympic Peninsula, Washington, and south along the coast to southern Oregon; occurring in some localities with *oregonensis.*

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[1] From Glacier, B. C.; Coolin, Idaho; and Stanton Lake and Nyack, Mont.

[2] Collection Provincial Mus., Victoria, B. C.

Characters.—Similar to *fuliginosus*, but upperparts, face, and feet much darker; colors much less rufescent than in *oregonensis*, both above and below; skull similar to that of *fuliginosus*, slightly larger than that of *oregonensis*.

Color.—Worn summer pelage: Upperparts wood brown; sides of face smoke gray shaded with cinnamon; eye-ring and upper surface of flying membrane fuscous-black; ears pale fuscous; feet fuscous, the soles shaded with buffy white; tail above, fuscous; beneath, dull light pinkish cinnamon, edged with fuscous; underparts whitish, heavily washed with pinkish cinnamon. *Winter pelage* (specimens from Ocean View, Oreg.):[1] Upperparts snuff brown; tail above, snuff brown heavily shaded with fuscous or fuscous-black; feet deep mouse gray; otherwise as in summer.

Skull.—Essentially the same as in *fuliginosus;* very similar to that of *oregonensis*, but averaging slightly larger.

Measurements.—Average of 4 topotypes (subadult): Total length, 335 (328–346); tail vertebræ, 162 (159–166); hind foot, 37.3 (35–39). *Skull:* Greatest length, 41 (40.3–41.6); zygomatic breadth, 23.9 (23.4–24.7); mastoidal breadth, 18.6 (18.4–19); least interorbital breadth, 8.2 (7.6–8.5); least postorbital breadth, 9.1 (8.8–9.4); length of nasals, 12.4 (11.2–13.2); maxillary toothrow, 8.4 (8.3–8.5).

Type specimen.—No. 5902, Field Mus. Nat. Hist.; ♂ subad., skin and skull; collected September 10, 1898, by D. G. Elliot.

Remarks.—The Olympic flying squirrel is apparently the darkest of the American forms. It is most nearly related to *oregonensis*, from which it differs in much less rufescent coloration. The material at hand is insufficient to show clearly whether the two races intergrade. The occurrence of typical specimens of both forms in the Olympic Mountains and at Gold Beach, Oreg., argues for their specific distinctness, but, on the other hand, a series from Ocean View, Oreg., strongly suggests intergradation, some of the specimens being clearly intermediate in color between *olympicus* and *oregonensis*. In view of the close cranial relationship which *olympicus* bears to both *oregonensis* and *fuliginosus* it seems best to unite it with them as a subspecies of *sabrinus*. To clear up the problem much additional material is needed—particularly a good series of winter specimens from the type region. At present the only available specimens in winter pelage are those from Ocean View, Oreg., which, as already explained, may be shading toward *oregonensis*.

Specimens examined.—Total number, 15, as follows:

Oregon: Gold Beach, 1;[2] Ocean View, 9.[3]
Washington: Olympic Mountains, 4;[2] Seattle, 1.[3]

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[1] Possibly not typical—see Remarks.
[2] Collection Field Mus. Nat. Hist.
[3] Collection Game Dept. Oregon.

GLAUCOMYS SABRINUS BULLATUS Howell.

Sawtooth Mountains Flying Squirrel.

[Pl. III, fig. 12; Pl. V, fig. 12; Pl. VII, fig. 4.]

Glaucomys bullatus Howell, Proc. Biol. Soc. Washington, XXVIII, p. 113, May 27, 1915.

Type locality.—Sawtooth [Alturas] Lake, Idaho.

Distribution.—Sawtooth Mountains, Idaho, north to Cranbrook, British Columbia, and west to the Blue Mountains, Oregon (fig. 4).

Characters.—Similar to *klamathensis*, but larger, with much larger bullæ; upperparts more pinkish, underparts tinged with avellaneous instead of yellow, tail darker above and more vinaceous below, and soles of hind feet smoke gray instead of olive-ochre. Similar in color to *bangsi*, but upperparts decidedly more pinkish (less vinaceous or drab); gray on face purer and more extensive; size much larger.

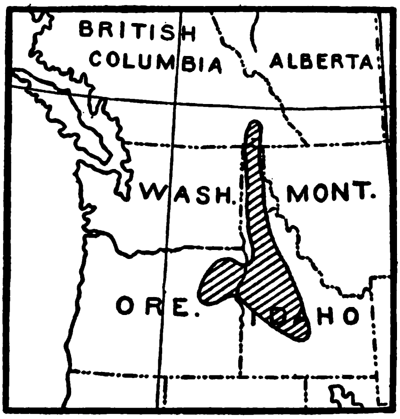

Fig. 4.—Map showing the distribution of *Glaucomys sabrinus bullatus*, based on specimens examined. This form occurs in some localities with others of the same species (see fig. 3, p. 30).

Color.—*Winter pelage:* Upperparts between pinkish cinnamon and cinnamon-buff, shaded in some specimens with wood brown, becoming paler on the face; sides of face and neck pale smoke gray, this color extending back to a point slightly behind the ears; ears dark hair-brown edged with fuscous and often partly clothed with smoke gray hairs; upper surface of flying membrane between hair-brown and fuscous; feet between mouse gray and hair-brown, the fore feet and toes of hind feet often marked with grayish white, the soles pale smoke gray; tail above, pinkish cinnamon much mixed with fuscous, becoming dark mouse gray at tip; beneath, dull light pinkish cinnamon; underparts creamy white, strongly shaded with avellaneous or light pinkish cinnamon, becoming pure avellaneous on sides. *Summer pelage:* Hind feet somewhat paler (about mouse gray) but otherwise as in winter.

Skull.—Size large (averaging largest of the races of *sabrinus*); braincase relatively narrow and very deep, abruptly depressed posteriorly; interorbital region depressed and fronto-parietal region markedly elevated; interorbital region broad, the interorbital notch obsolete or much reduced; audital bullæ very large; basioccipital relatively narrow; molar teeth massive.

Measurements.—Type: Total length, 340; tail vertebræ, 150; hind foot, 46. Average of 6 adults from Ketchum, Idaho: Total length, 336 (327–354); tail vertebræ, 142 (135–150); hind foot, 42.5 (39–45). *Skull:* Average of type and of 5 adults from Ketchum, Idaho: Greatest length, 43.3 (42.4–44.2); zygomatic breadth, 25 (24.4–25.5); mastoidal breadth, 19.3 (19–20); least interorbital breadth, 8.9 (8.1–9.6); least postorbital breadth, 9.4 (9–9.7); length of nasals, 13.6 (13.5–13.9); maxillary toothrow, 9.1 (8.8–9.3).

Type specimen.—No. $\frac{24371}{31675}$, U. S. Nat. Mus. (Biological Survey collection): ♀ ad., skin and skull; collected September 28, 1890, by Vernon Bailey and B. H. Dutcher.

Remarks.—This race is the largest and one of the handsomest of the American flying squirrels. It was originally believed to be a distinct species, since it occurs at the same localities with *bangsi* in Idaho and with *latipes* in British Columbia, and does not intergrade with them, but recently acquired material from eastern Oregon shows intergradation with *klamathensis*. An adult from Beech Creek, Oreg., agrees well with typical *bullatus* in color, and its skull is slightly larger than the largest of the Idaho series; the braincase, however, is relatively broader and flatter. Another adult from Cornucopia, Oreg., approaches *klamathensis* in having the belly and the soles tinged with colonial buff. A specimen from Cranbrook, British Columbia, differs from the Idaho series in having the underparts a slightly darker shade of cinnamon and the tail more extensively shaded with fuscous.

Specimens examined.—Total number, 14, as follows:

British Columbia: Cranbrook, 1.
Idaho: Ketchum, 6;[1] Sawtooth Lake, 2.
Oregon: Anthony, 1;[2] Beech Creek, 1; Cornucopia, 3.

GLAUCOMYS SABRINUS KLAMATHENSIS (MERRIAM).

KLAMATH FLYING SQUIRREL.

[Pl. III, fig. 8; Pl. V, fig. 3; Pl. VII, fig. 8.]

Sciuropterus alpinus klamathensis Merriam, Proc. Biol. Soc. Washington, XI, p. 225, July 15, 1897.

Type locality.—Fort Klamath, Oregon.

Distribution.—Central Oregon, chiefly east of the Cascades; northern and eastern limits unknown.

Characters.—Similar to *fuliginosus* but upperparts averaging slightly paler; gray on face purer and more extensive (less mixed with buff); underparts paler, usually washed with pale yellow; soles strongly tinted with yellow; audital bullæ larger. Similar to *bullatus* but bullæ smaller, colors paler, and underparts and soles shaded with yellowish.

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[1] Collection Mus. Comp. Zool.

[2] Collection Amer. Mus. Nat. Hist.

Color.—*Winter pelage:* Upperparts cinnamon-drab or pale sayal brown shading in some specimens to light yellowish drab; sides of face smoke gray, often considerably washed with pinkish cinnamon; upper surface of flying membrane fuscous; ears drab or pale hair-brown; hind feet hair-brown, the soles olive-ochre or deep colonial buff; fore feet light brown mixed with buffy white; tail above, sayal brown or dull cinnamon, much mixed with hair-brown, the tip nearly pure hair-brown; beneath, pinkish buff, light pinkish cinnamon, or colonial buff, moderately shaded with hair-brown, chiefly on sides; underparts whitish, rather heavily washed with colonial buff or cream-buff, shading to light pinkish cinnamon along sides.

Skull.—Similar to that of *fuliginosus* but with larger bullæ; similar to that of *bullatus* but smaller, with smaller bullæ and flatter braincase.

Measurements.—Average of 9 topotypes (adult and subadult): Total length, 319 (300–336); tail vertebræ, 144 (135–154); hind foot, 40.4 (39.5–42). *Skull:* Average of 6 topotypes (adult and subadult): Greatest length, 40.9 (40.2–42.3); zygomatic breadth, 23.6 (23.2–25); mastoidal breadth, 18.9 (18.6–19.6); least interorbital breadth, 7.8 (7–9); least postorbital breadth, 9.2 (8.6–10); length of nasals, 12.7 (11.8–13.9); maxillary toothrow, 8.6 (8.1–9).

Type specimen.—No. 87310, U. S. Nat. Mus. (Biological Survey collection); ♀ ad., skin and skull; collected January 11, 1897, by B. L. Cunningham.

Remarks.—This race occupies the interior of Oregon, chiefly east of the Cascades, but extending into the eastern foothills of that range and occasionally as high as Crater Mountain (4 miles south of Crater Lake). It intergrades with *fuliginosus* in the Cascades and with *flaviventris* in northeastern California. A series of specimens from Davis Mountain, Crook County, Oreg., exhibit the characters of the subspecies in a more pronounced way than the series from the type locality. In color they are more drab above and have the underparts and feet more intensely yellowish; the skulls average somewhat larger. A specimen from Paulina Lake, Oreg., differs from typical specimens in having gray instead of yellow feet, and approaches *fuliginosus* also in the color of the back and underparts.

Specimens examined.—Total number, 27, as follows:

Oregon: Crater Mountain (4 miles south of Crater Lake), 1; Davis Mountain, Crook County, 7;[1] Fort Klamath, 17; Paulina Lake, 1; "Upper Klamath" [Lake], 1.[2]

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[1] Collection Game Dept. Oregon.

[2] Collection Field Mus. Nat. Hist.

GLAUCOMYS SABRINUS FLAVIVENTRIS Howell.

Yellow-Bellied Flying Squirrel.

[Pl. III, fig. 2; Pl. V, fig. 2; Pl. VII, fig. 2.]

Glaucomys sabrinus flaviventris Howell, Proc. Biol. Soc. Wash., XXVIII, p. 112, May 27, 1915.

Type locality.—Head of Bear Creek, Trinity County, California (altitude, 6,400 feet).

Distribution.—Northern California, from the Trinity Mountains in Siskiyou and Trinity Counties east to the Warner Mountains, Modoc County.

Characters.—Similar to *klamathensis* but smaller, with much smaller audital bullæ; underparts and feet more strongly suffused with yellow or buff; tail darker beneath.

Color.—*Summer pelage:* Upperparts pale sayal brown varying in some specimens to drab; sides of head smoke gray, often tinged with buff; ears hair-brown; upper surface of flying membrane fuscous; feet hair-brown, often tinged with pale greenish yellow, the soles oil yellow; tail above, dark buffy brown, shading to pale fuscous at tip; beneath, brownish cream-buff, bordered on sides with pale fuscous or hair-brown; underparts whitish, usually heavily washed with pale greenish yellow or Naples yellow, shading to wood brown along sides; a small white patch on throat, the hairs white to the roots.

Skull.—Similar to that of *klamathensis*, but decidely smaller, with much smaller bullæ; much smaller than that of *fuliginosus;* closely similar to that of *lascivus.*

Measurements.—Average of 5 topotypes (adult): Total length, 306 (286–322); tail vertebræ, 133 (122–140); hind foot, 40.4 (40–42). *Skull:* Greatest length, 39.5 (38.7–40.4); zygomatic breadth, 23.5 (23.2–24.2); mastoidal breadth, 17.9 (17.6–18.7); least interorbital breadth, 7.2 (6.3–8.3); least postorbital breadth, 8.9 (8.2–9.8); length of nasals, 12.3 (11.8–12.6); maxillary toothrow, 8.4 (7.7–8.8).

Type specimen.—No. 13319, Mus. Vert. Zool., Univ. California; ♂ ad., skin and skull; collected August 13, 1911, by Annie M. Alexander.

Remarks.—This race is apparently most nearly related to *lascivus* of the Sierra Nevada, from which it differs widely in color of underparts. It differs so much from *oregonensis*, both in color and cranial characters, that intergradation between them seems very improbable. Specimens from the Warner Mountains, Cal., are intermediate between this form and *klamathensis;* in color they resemble *flaviventris*, but one of the two individuals has a skull equaling that of *klamathensis*, though with smaller bullæ. A large series from Rush Creek, Siskiyou County, average slightly less yellowish beneath and have somewhat larger skulls than typical specimens, some of them equaling skulls of *fuliginosus* in size. Intergradation with *lascivus* occurs in the region around Mount Lassen.

Specimens examined.—Total number, 27, as follows:

California:[1] Bear Creek, Trinity County (head, altitude, 6,400 feet), 5; Castle Lake, Siskiyou County, 2; Grizzly Creek, Trinity County (altitude, 6,000 feet), 1; Jackson Lake, Siskiyou County, 3; Rush Creek, Siskiyou County, 14; Warner Mountains, 2.

GLAUCOMYS SABRINUS LASCIVUS (BANGS).

SIERRA FLYING SQUIRREL.

[Pl. III, fig. 5; Pl. V, fig. 5; Pl. VII, fig. 1.]

Sciuropterus alpinus lascivus Bangs, Proc. New England Zool. Club, I, p. 69, July 31, 1899.

Type locality.—Tallac, Eldorado County, California.

Distribution.—Sierra Nevada Range and northward to eastern Shasta County, California.

Characters.—Similar to *flaviventris*, but slightly smaller, with smaller hind foot; underparts without yellow suffusion. Compared with *klamathensis:* Size smaller; color above more drab (less brownish); underparts and feet less yellowish. Similar in color to *stephensi*, but paler.

Color.—*Winter pelage:* Upperparts wood brown shading to drab; sides of face smoke gray, often shaded with pale fuscous; upper surface of flying membrane blackish brown; ears fuscous-black; hind feet hair-brown, the toes shaded with whitish or buff; fore feet mouse gray; tail above, fuscous-black mixed with wood brown or pale snuff brown; beneath, drab-gray shading to avellaneous; underparts grayish white faintly washed with avellaneous. *Summer pelage:* Upperparts more brownish, usually rich wood brown; underparts faintly washed with cartridge buff or light pinkish cinnamon; upper surface of membranes clove brown; hind feet pale hair-brown, the soles whitish drab or faintly tinged with olive-buff; under side of tail pinkish buff.

Skull.—Essentially like that of *flaviventris;* much smaller than that of *klamathensis* and of *fuliginosus.*

Measurements.—Average of 5 topotypes (adult and subadult): Total length, 303 (295–320); tail vertebræ, 133 (125–150); hind foot, 40.2 (39–43). Average of 11 from Cisco, Cal.: 292; 122; 37.5. *Skull:* Average of 4 topotypes (adult and subadult): Greatest length, 40.4 (39.5–41.5); zygomatic breadth, 23.5 (23–24.1); mastoidal breadth, 18.2 (17.7–18.8); least interorbital breadth, 7.4 (7.1–7.8); least postorbital breadth, 9.2 (9–9.5); length of nasals, 13 (12.7–13.2); maxillary toothrow, 8.1.

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[1] All in collection Mus. Vert. Zool., Univ. California.

Type specimen.—No. 9186, Mus. Comp. Zool. (formerly in collection of E. A. and O. Bangs); ♀ subad., skin and skull; collected August 28, 1898, by W. W. Price and P. O. Simons.

Remarks.—The Sierra flying squirrel is closely related to *flaviventris* of northern California, but differs markedly from it in the color of the underparts, tail, and feet. Intergradation between the two forms is shown by specimens from Mount Lassen, Dana, Prattville, and Castle Lake, Siskiyou County, which approach *flaviventris* in having the soles yellowish and the underparts tinged with the same. One specimen from Echo, close to the type locality, also has yellow soles and a buffy tail, but no yellow on the belly. In a large series from Cisco, Cal., most of the specimens show indications of being stained on the underparts with soot. Intergradation with *californicus* is probable, but there is no material available from the southern Sierra to show it. This race is very similar in color to *alpinus* of the northern Rocky Mountains, but is of much smaller size and has a paler tail.

Specimens examined.—Total number, 34, as follows:

California: Blue Canyon, 3;[1] Cisco, 18;[1] Dana, 1; Echo, 1;[2] Fort Crook, 1; Fresno [=mountains near ?], 1 (skeleton); Kings River Canyon, 1; Mill Creek, south base Mount Lassen, 1; Mount Tallac, 4;[2, 3] Prattville (12 miles northeast), 1; Quincy, 1; Red Point, Placer County, 1.[4]

GLAUCOMYS SABRINUS CALIFORNICUS (Rhoads).

San Bernardino Flying Squirrel.

[Pl. III, fig. 9; Pl. V, fig. 9; Pl. VII, fig. 5.]

Sciuropterus alpinus californicus Rhoads, Proc. Acad. Nat. Sci., Philadelphia, p. 323, June, 1897.

Sciuropterus californicus Grinnell, Univ. California, Publ. Zool., V, pp. 138–139, 1908.

Type locality.—Squirrel Inn, San Bernardino Mountains, California (altitude, 5,200 feet).

Distribution.—San Bernardino and San Jacinto Mountains, California.

Characters.—Similar to *lascivus*, but upperparts paler and more grayish; face between eyes usually washed with gray; skull smaller.

Color.—*Unworn pelage* (April to August): Upperparts light drab, shaded in some specimens with yellowish wood brown; sides of face pale smoke gray; front of face often washed with gray; ears hair-brown; upper surface of flying membrane fuscous; feet hair-brown or mouse gray, the toes whitish or buffy white, the soles buffy white or olive-buff; tail above, hair-brown, sparingly mixed with sayal brown; beneath, pinkish buff or pale olive-buff, edged on sides with hair-brown; underparts soiled whitish, faintly shaded with cartridge buff.

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[1] Collection Mus. Vert. Zool., Univ. California.

[2] Collection Mus. Comp. Zool.

[3] Collection Acad. Nat. Sci. Philadelphia.

[4] Collection Leland Stanford, Jr., Univ.

Skull.—Similar to that of *lascivus*, but averaging smaller, with shorter nasals and smaller bullæ.

Measurements.—Average of 8 adults from San Bernardino Mountains, Cal.: Total length, 297 (280–312); tail vertebræ, 137 (127–149); hind foot, 37.6 (36–39). *Skull:* Average of 5 adults from same locality: Greatest length, 39 (37.3–40); zygomatic breadth, 22.8 (22.3–23.5); mastoidal breadth, 17.7 (17.2–18.1); least interorbital breadth, 7.8 (7.4–8.2); least postorbital breadth, 8.7 (7.9–9.6); length of nasals, 11.9 (11.3–12.4); maxillary toothrow, 8.1 (7.5–8.6).

Type specimen.—No. 10487, Acad. Nat. Sci. Philadelphia (formerly No. 3487, collection S. N. Rhoads).; ♀ ad., skin and skull; collected June 5, 1896, by R. B. Herron.

Remarks.—This subspecies is the grayest of the races of *sabrinus*, being considerably paler than *alpinus*. It is closely related to *lascivus* of the Sierra, and probably intergrades with it, though no intermediate specimens have thus far been collected.

Specimens examined.—Total number, 9, as follows:

California: San Bernardino Mountains, 8;[1] San Jacinto Mountains, 1.[2]

GLAUCOMYS SABRINUS STEPHENSI (MERRIAM).

CALIFORNIA COAST FLYING SQUIRREL.

[Pl. III, fig. 1; Pl. V, fig. 1; Pl. VII, fig. 9.]

Sciuropterus oregonensis stephensi Merriam, Proc. Biol. Soc. Washington, XIII, p. 151, June 13, 1900.

Type locality.—Sherwood, Mendocino County, California.

Distribution.—Coast region of northern California; limits of range unknown.

Characters.—Similar to *lascivus*, but upperparts more reddish (less drab); soles whiter (never tinged with yellowish) and toes less distinctly marked with buffy or white; skull with very deep braincase. Compared with *oregonensis:* Upperparts and tail less reddish; underparts whiter. Compared with *fuliginosus:* Size much smaller; color above in fresh pelage somewhat grayer (less ochraceous) and underparts paler.

Color.—*Fresh winter pelage:* Upperparts wood brown; sides of face pale smoke gray; upper surface of flying membrane fuscous or fuscous-black; feet hair-brown, the soles buffy white; tail above, hair-brown, shaded with fuscous-black, darkest at tip; beneath, pale pinkish buff edged with hair-brown; underparts whitish, irregularly washed with light pinkish cinnamon. *Worn winter pelage* (May): Upperparts decidedly more brownish, about sayal brown; tail above, somewhat browner; beneath, light pinkish buff, edged with fuscous. *Summer pelage* (July): Similar to spring pelage but underside of tail darker (pinkish buff).

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[1] Three in collection Acad. Nat. Sci. Philadelphia; three in Mus. Vert. Zool., Univ. California; one in Mus. Comp. Zool.

[2] Collection Mus. Vert. Zool., Univ. California.

Skull.—Similar to that of *oregonensis* and of *lascivus*, but averaging slightly smaller, with relatively shorter nasals and slightly smaller bullæ; braincase deeper and more abruptly depressed.

Measurements.—Average of 3 adults from Laytonville, Cal.: Total length, 307 (300–310); tail vertebræ, 143 (133–149); hind foot, 39.3 (38–40) *Skull:* Average of 3 adults from Laytonville, Cal.: Greatest length, 40 (39.7–40.5); zygomatic breadth, 23.5 (23–24); mastodial breadth, 18.3 (18.3–18.4); least interorbital breadth, 7.9 (7.6–8.4); least postorbital breadth, 9.2 (8.6–9.9); length of nasals, 11.7 (11.1–12.6); maxillary toothrow, 7.9 (7.3–8).

Type specimen.—No. 99830, U. S. Nat. Mus. (Biological Survey collection); ♀ subad., skin and skull; collected May 10, 1894, by F. Stephens.

Remarks.—This race, as indicated by its skull, is closely related to *oregonensis;* in color it resembles *lascivus* rather closely, and doubtless intergrades with both it and *oregonensis.* The type (from Sherwood) and one nearly adult specimen from Laytonville have skulls in which the occipital region is very abruptly decurved, but in two other adults from the same locality this character is less pronounced. A specimen, without skull, from 8 miles southeast of Cecilville—within the known range of *flaviventris*—agrees essentially with the type of *stephensi*, and thus suggests that intergradation does not occur between these two races.

Specimens examined.—Total number, 6, as follows:

California: Cecilville (8 miles southeast), 1;[1] Eureka, 1;[2] Laytonville, 3;[3] Sherwood, 1.

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[1] Collection Mus. Vert. Zool., Univ. California.
[2] Collection Leland Stanford, Jr., Univ.
[3] Collection California Acad. Sci.

TABLES OF CRANIAL MEASUREMENTS.

TABLE I.—*Glaucomys volans.*

No.	Species and locality.	Sex.	Greatest length.	Zygomatic breadth.	Mastoidal breadth.	Interorbital breadth.	Postorbital breadth.	Length of nasals.	Maxillary toothrow.	Remarks.
	Glaucomys volans volans:		*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	
155510	Washington, D. C	♀	34.1	20.9	17	7	9.1	9.6	6.2	Adult.
155517	Do	♀	34.9	20.9	16.6	7.3	9.3	9.8	6.3	Subadult.
155518	Do	♂	35.4	21.2	16.8	7	9.2	10.1	6.5	Adult.
155512	Do	♂	34.6	20.4	16.5	6.2	8.6	9.2	6	Do.
47683	Lake George, N. Y	♂	33.9	21.1	16.6	6.5	8.4	9.6	5.6	Do.
78010	Wilmington, Mass	♀	35.7	22.1	17	7.5	8.9	9.9	6.6	Do.
194040	Elk River, Minn	♂	33.6	20.5	16.5	6.9	9.1	9.1	6.5	Do.
194033	Do	♀	35.5	21.5	16.7	7	9.4	9.9	6.4	Do.
	Glaucomys v. querceti:									
[1] 2451	Citronelle, Fla	♀	35.3	20.9	17.5	6.6	8.2	9.4	6.3	Adult; type.
[1] 2453	Do	♀	34.4	20.7	......	6.9	8.6	9	6.4	Adult.
78969	Lake Harney, Fla	♂	34.3	20.7	17.5	6.8	8.3	9.6	6.5	Subadult.
72572	Enterprise, Fla	♂	34.5	19.5	16.8	7.2	8.7	9.6	6.4	Do.
	Glaucomys v. saturatus:									
178364	Dothan, Ala	♀	33.8	20.2	17	6.8	9.1	9.7	6.4	Adult.
178366	Do	♀	34.9	20.4	17.4	7.2	8.3	9.5	6.5	Adult; type.
178363	Do	♂	34.4	20.5	17.3	7.3	9	10	6.7	Adult.
57032	Greensboro, Ala	♂	34.3	20.2	16.8	7.3	8.4	9.7	6.2	Do.
	Glaucomys v. texensis:									
136790	Sour Lake, Tex	♂	32.7	20.6	17.1	7	8.2	9.5	6.4	Subadult.
136400	Do	♂	34	20.9	17.2	7.3	8.9	9.2	6.3	Old adult; type.
136401	Do	♀	33.6	21	17.2	7.3	8.9	9.2	6.2	Adult.
136402	Do	♀	33.6	20.9	17.4	6.9	8.5	9.2	6.1	Do.
	Glaucomys v. goldmani:									
132633	Teopisca, Chiapas	♂	35.1	21.3	17.8	7.2	8.7	10.3	6.4	Adult; type.
132634	Do	♀	34.9	21.9	17.5	7.2	9.2	9.9	6.3	Adult.

[1] Collection Mus. Comp. Zool.

TABLE II.—*Glaucomys sabrinus.*

No.	Species and locality.	Sex.	Greatest length.	Zygomatic breadth.	Mastoidal breadth.	Interorbital breadth.	Postorbital breadth.	Length of nasals.	Maxillary toothrow.	Remarks.
	Glaucomys sabrinus sabrinus:		*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	
[1] ——	Cochrane, Ontario	♂	40	24	18.1	7.3	8.9	11.5	7.8	Subadult.
[2] 7596	Lake Edward, Quebec	♀	39.4	24.2	18.5	8.1	9.7	11.4	7.3	Adult.
[3] 5432	Big Island, Mackenzie	....	40.2	24.2	19.2	8.2	9.2	12.8	8.1	Subadult.
3756	Winnipeg, Manitoba	♀	39.4	24.3	18	7.8	9.3	12	7.7	Do.
	Glaucomys s. makkovikensis									
[3] 12451	Makkovik, Labrador	....	40.8	24.7	......	7.3	10	12.2	7.4	Adult.
[3] 12453	Do	....	40.4	24.4	18.6	7.6	9.7	11.1	7.9	Do.
	Glaucomys s. macrotis:									
83152	Hunter Mountain, N. Y	♀	37.5	22.4	17.5	7	9.3	10.6	7.1	Adult; type.
111075	Peterboro, N. Y	♂	36.7	22.4	17.7	7.1	9.2	10.5	6.4	Adult.
71175	Ossipee, N. H	♂	36	22.3	17.2	6.9	8.6	10.5	7.2	Do.
[3] 4960	Greenville, Me	♀	38.7	23.5	17.9	6.8	8.9	10.1	6.7	Do.
	Glaucomys s. canescens:									
[2] 7662	Portage la Prairie, Manitoba	♂	38.5	22.8	17.5	7.7	9.2	11.5	7.7	Do.
[2] 7663	Do	♀	38.8	22.9	17.6	7.6	9.5	11.2	7.6	Adult; type.

[1] Collection Carnegie Mus.; not numbered.

[2] Collection Field Mus. Nat. Hist.

[3] Collection Mus. Comp. Zool.

TABLE II.—*Glaucomys sabrinus*—Continued.

No.	Species and locality.	Sex.	Greatest length.	Zygomatic breadth.	Mastoidal breadth.	Interorbital breadth.	Postorbital breadth.	Length of nasals.	Maxillary toothrow.	Remarks.
			Mm.	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm*	*Mm.*	
	Glaucomys s. bangsi:									
[1] 6959	Idaho Co., Idaho	♂	38.8	23.7	18.6	7.4	8.4	11.5	8.7	Subadult; type.
31674	Sawtooth Lake, Idaho	♂	40.9	24.8	18.7	7.8	9	11.8	8.7	Adult.
169169	Florence, Mont	♀	41.2	24.7	19.1	7.8	9	12.4	8	Do.
	Glaucomys s. alpinus:									
88646	Jasper House, Alberta	♂	41.4	25.4	19.4	8	9	12.4	8.1	Do.
174398	Henry House, Alberta	♀	41.2	25.1	19.4	8.2	9.1	12.6	7.5	Do.
174397	Do	♀	42	25.6	19.4	8.8	9.6	12.4	7.9	Subadult.
	Glaucomys s. yukonensis:									
35320	Camp Davidson, Alaska	♀	41.5	25.3	19.5	7.8	10.3	12	7.9	Adult; type.
180338	Tanana, Alaska	♀	41	25.1	19.7	8.3	8.9	11.6	8.4	Adult.
	Glaucomys s. zaphæus:									
136137	Helm Bay, Alaska	♀	41.5	26.2	19.1	8.3	9	12.9	8	Adult; type.
136138	Do	♂	40.1	24.2	18.2	7.4	8.8	12.3	8.3	Subadult.
[2] 8790	Bradfield Canal, Alaska	♀	41.2	24.7	18.9	8.4	9.2	12.6	7.8	Very old.
	Glaucomys s. oregonensis:									
[3] 253	Columbia River, Oreg	....	40.5+	24.8	19	8.5	8.9	12.4	8.1	Adult; type.
[4] 146	Salem, Oreg	♂	40.7	24.9	18.6	8.1	8.7	12.9	8.7	Adult.
141952	Portland, Oreg	♂	40.5	23.7	19	8.8	9	12.5	8	Do.
69416	Gold Beach, Oreg	♀	38.5	23	18.2	7.6	8.1	10.9	7.9	Old adult.
	Glaucomys s. columbiensis:									
94310	Okanogan, B. C	♂	40.5	24.4	18.9	7.7	9.2	12	7.7	Subadult; type.
[5] 1026	Penticton, B. C	♀	41.2	25.2	19.4	7.7	8.4	12.9	7.7	Old adult.
206543	Cranbrook, B. C	♀	41.6	24.6	19.5	8.6	9	12.6	8	Do.
	Glaucomys s. fuliginosus:									
[3] 8058	Martin Station, Wash	♂	39.5	23.7	......	8.4	9.3	12.6	8.6	Subadult; type.
93282	Keechelus Lake, Wash	♀	42.5	24.3	19.1	9	9.6	13	8.8	Subadult.
93144	Do	....	41.9	24.4	18.8	8.6	8.8	13	8.2	Adult.
	Glaucomys s. latipes:									
68573	Glacier, B. C	♀	44.2	25.1	20	8.3	9	14	8.8	Adult; type.
159393	Coolin, Idaho	♀	43.7	24.2	19.5	8	9	13.6	9	Adult.
159394	Do	♂	41.6	24	19	8	8.8	12.5	8	Do.
	Glaucomys s. olympicus:									
[6] 5902	Olympic Mountains, Wash	♂	41.5	23.7	18.4	8.2	8.8	13.2	8.5	Subadult; type.
[6] 5905	Do	♂	41.6	24.7	19	8.4	8.9	12.5	8.3	Subadult.
[6] 5904	Do	♂	40.5	23.7	18.5	7.6	9.2	12.5	8.3	Do.
	Glaucomys s. bullatus:									
31675	Sawtooth Lake, Idaho	♀	44	25	19	8.7	9.6	13.9	9.2	Adult; type.
[1] 8499	Ketchum, Idaho	♂	44.2	25.5	19.4	9.6	9.2	13.5	9.3	Adult.
[1] 8495	Do	♂	42.6	24.4	19	8.1	9	13.9	9.2	Do.
	Glaucomys s. klamathensis:									
87310	Fort Klamath, Oreg	♀	40.6	24	18.8	9	8.7	12.6	8.1	Old adult; type.
193991	Do	♂	40.2	23.4	19	7.8	10	12.7	8.4	Old adult.
87305	Do	....	42.3	25	19.6	8.3	9.4	13.9	8.7	Adult.
	Glaucomys s. flaviventris:									
[2] 13319	Bear Creek, Trinity Co., Cal	♂	40	23.4	17.9	7.9	9.3	12.3	8.1	Adult; type.
[2] 13321	Do	♀	40.4	24.2	18.7	8.3	9.8	11.8	8.7	Adult.
[2] 13318	Do	♀	38.7	23.3	17.6	7.2	8.7	12.6	7.7	Do.
	Glaucomys s. lascivus:									
[1] 9186	Mount Tallac, Cal	♀	39.5	23	17.7	7.8	9.5	12.8	8.1	Subadult; type.
[1] 9187	Do	♀	1.5	23.3	18.8	7.2	9.2	13.2	8.2	Subadult.
[2] 11458	Do	♀	40.4	24.1	18.4	7.6	9	12.7	......	Adult.
	Glaucomys s. californicus:									
[2] 10487	San Bernardino Mountains, Cal.	♀	39.3	23.5	17.6	8.2	9.2	11.7	8.1	Old adult; type.
[2] 10486	Do	♀	37.3	22.3	18.1	7.4	7.9	11.3	7.5	Old adult.
[1] 8646	Do	♀	40	22.9	18	7.4	8.4	12.1	7.7	Do.
	Glaucomys s. stephensi:									
99830	Sherwood, Cal	♀	38.4	22.5	17.4	7.4	9.5	11.7	7.5	Subadult type.

[1] Collection Mus. Comp. Zool.

[2] Collection Mus. Vert. Zool., Univ. California.

[3] Collection Acad. Nat. Sci., Philadelphia.

[4] Collection Game Dept. Oregon.

[5] Collection Victoria Mem. Mus.

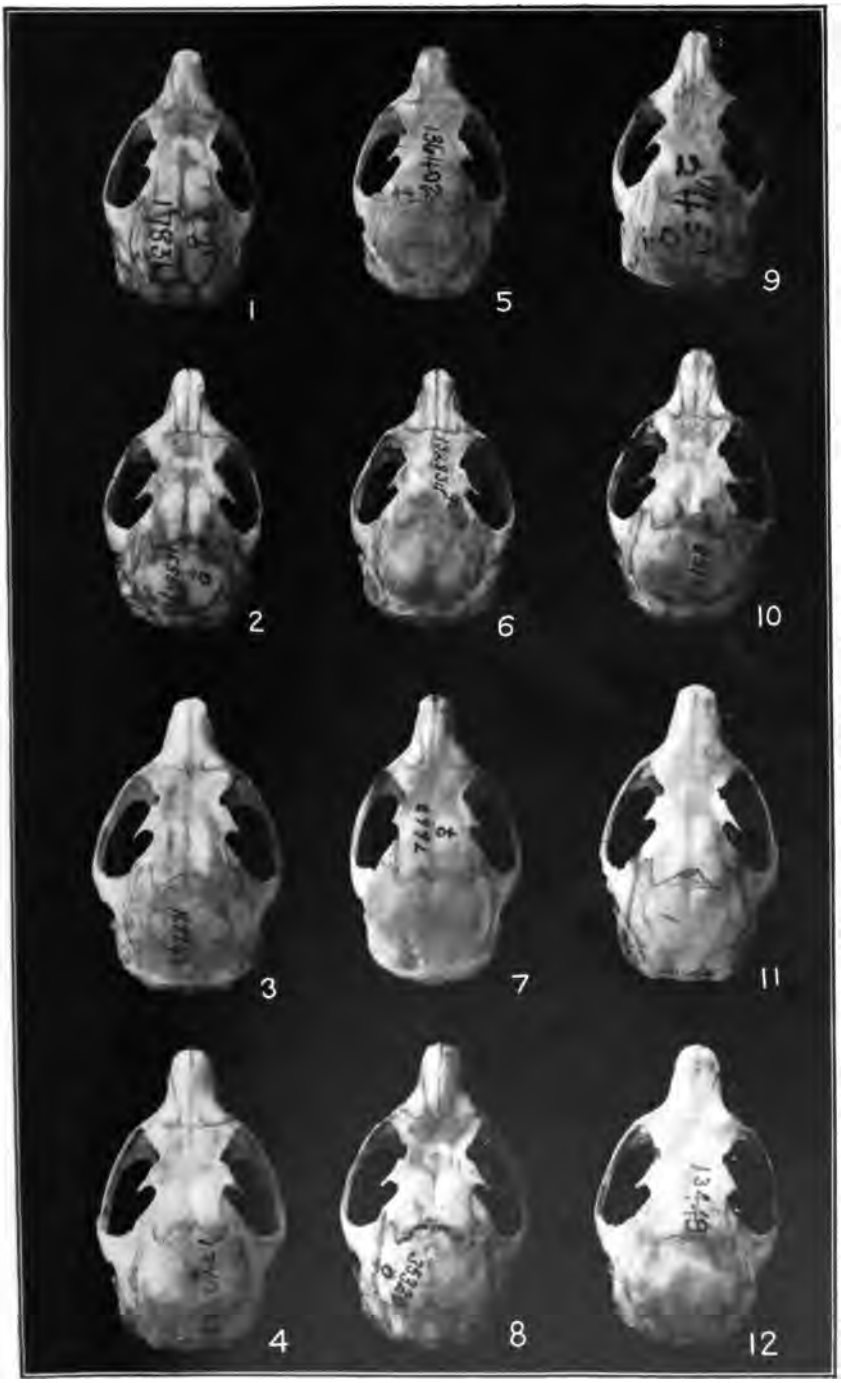
[6] Collection Field Mus. Nat. Hist.

EXPLANATION OF PLATES.

[All natural size.]

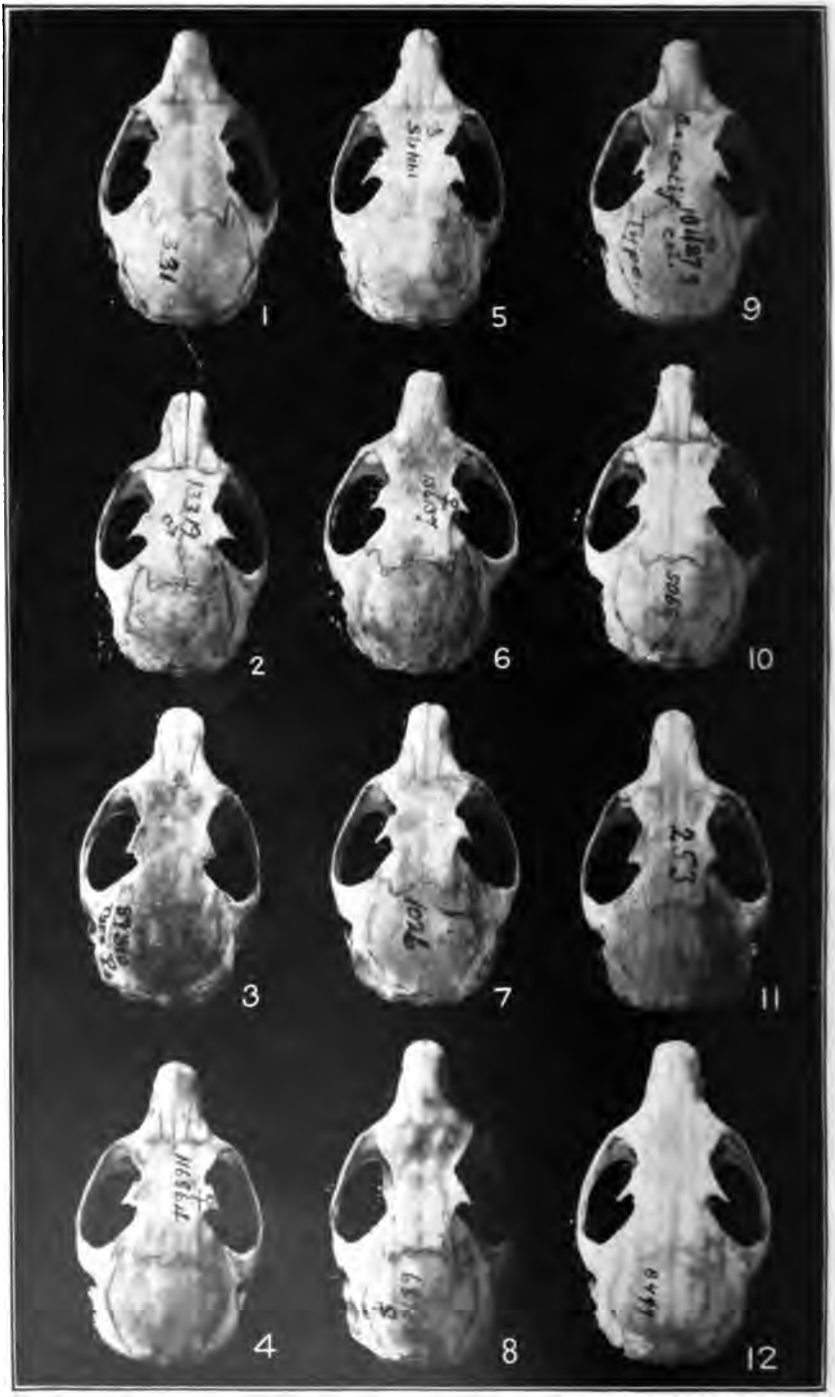
PLATE II.

Fig. 1. *Glaucomys volans saturatus*, ♂ ad., Dothan, Ala. (No. 178363, U. S. Nat. Mus., Biological Survey collection).
Fig. 2. *Glaucomys volans volans*, ♀ ad., Cleveland Park, D. C. (No. 155517, U. S. Nat. Mus.).
Fig. 3. *Glaucomys sabrinus bangsi*, ad., Florence, Mont. (No. 168243, U. S. Nat. Mus., Biological Survey collection).
Fig. 4. *Glaucomys sabrinus alpinus*, ♀ ad., Henry House, Alberta (No. 174398, U. S. Nat. Mus.).
Fig. 5. *Glaucomys volans texensis*, ♀ ad., Sour Lake, Tex. (No. 136402, U. S. Nat. Mus., Biological Survey collection).
Fig. 6. *Glaucomys volans goldmani*, ♀ ad., Teopisca, Chiapas (No. 132834, U. S. Nat. Mus., Biological Survey collection).
Fig. 7. *Glaucomys sabrinus canescens*, ♀ ad. (type), Portage la Prairie, Manitoba (No. 7663, Field Mus. Nat. Hist.).
Fig. 8. *Glaucomys sabrinus yukonensis*, ♀ ad. (type), Camp Davidson, Alaska (No. 35320, U. S. Nat. Mus.).
Fig. 9. *Glaucomys volans querceti*, ♀ ad. (type), Citronelle, Fla. (No. 2451, Mus. Comp. Zool.).
Fig. 10. *Glaucomys sabrinus macrotis*, ♀ ad. (type), Catskill Mountains, N. Y. (No. 83152, U. S. Nat. Mus.).
Fig. 11. *Glaucomys sabrinus sabrinus*, ♂ subad., Cochrane, Ontario (Carnegie Mus., not numbered).
Fig. 12. *Glaucomys sabrinus makkovikensis*, ad., Makkovik, Labrador (No. 13449, Mus. Comp. Zool.).



SKULLS OF GLAUCOMYS VOLANS AND G. SABRINUS.

1. **G. v. saturatus.**
2. **G. v. volans.**
3. **G. s. bangsi.**
4. **G. s. alpinus.**
5. G. v. texensis.
6. G. v. goldmani.
7. G. s. canescens.
8. G. s. yukonensis.
9. G. v. querceti.
10. G. s. macrotis.
11. G. s. sabrinus.
12. G. s. makkovikensis.



SKULLS OF GLAUCOMYS SABRINUS.

1. G. s. stephensi.
2. G. s. flaviventris.
3. G. s. klamathensis.
4. G. s. fuliginosus.
5. G. s. lascivus.
6. G. s. zaphæus.
7. G. s. columbiensis.
8. G. s. latipes.
9. G. s. californicus.
10. G. s. olympicus.
11. G. s. oregonensis.
12. G. s. bullatus.

PLATE III.

Fig. 1. *Glaucomys sabrinus stephensi*, ♂ ad., Laytonville, Cal. (No. 331, Cal. Acad. Sci.)

Fig. 2. *Glaucomys sabrinus flaviventris*, ♂ ad. (type), Bear Creek, Trinity County, Cal. (No. 13319, Mus. Vert. Zool.).

Fig. 3. *Glaucomys sabrinus klamathensis*, ♀ ad. (type), Fort Klamath, Oreg. (No. 87310, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys sabrinus fuliginosus*, ♀ ad., Easton, Wash. (No. 116864, U. S. Nat. Mus., Biological Survey collection).

Fig. 5. *Glaucomys sabrinus lascivus*, ♀ ad., Cisco, Cal. (No. 19495, Mus. Vert. Zool.).

Fig. 6. *Glaucomys sabrinus zaphœus*, ♀ ad. (type), Helm Bay, Alaska (No. 136137, U. S. Nat. Mus., Biological Survey collection).

Fig. 7. *Glaucomys sabrinus columbiensis*, ♀ ad., Penticton, B. C. (No. 1026, Victoria Mem. Mus.).

Fig. 8. *Glaucomys sabrinus latipes*, ♀ ad. (type), Glacier, B. C. (No. 68573, U. S. Nat. Mus., Biological Survey collection).

Fig. 9. *Glaucomys sabrinus californicus*, ♀ ad. (type), San Bernardino Mountains, Cal. (No. 10487, Acad. Nat. Sci. Philadelphia).

Fig. 10. *Glaucomys sabrinus olympicus*, ♂ subad., Olympic Mountains, Wash. (No. 5905, Field Mus. Nat. Hist.).

Fig. 11. *Glaucomys sabrinus oregonensis*, ad. (type), Columbia River, Oreg. (No. 253, Acad. Nat. Sci. Philadelphia).

Fig. 12. *Glaucomys sabrinus bullatus*, ♂ ad., Ketchum, Idaho (No. 8499, Mus. Comp. Zool.).

Plate VI.

Fig. 1. *Glaucomys volans volans*, ♀ ad., Cleveland Park, D. C. (No. 155517, U. S. Nat. Mus.).

Fig. 2. *Glaucomys volans querceti*, ♀ ad. (type), Citronelle, Fla. (No. 2451, Mus. Comp. Zool.).

Fig. 3. *Glaucomys volans saturatus*, ♂ ad., Dothan, Ala. (No. 178363, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys volans texensis*, ♀ ad., Sour Lake, Tex. (No. 136402, U. S. Nat. Mus., Biological Survey collection).

Fig. 5. *Glaucomys sabrinus macrotis*, ♀ ad. (type), Catskill Mountains, N. Y. (No. 83152, U. S. Nat. Mus.).

Fig. 6. *Glaucomys sabrinus sabrinus*, ♂ subad., Cochrane, Ontario (Carnegie Museum, not numbered).

Fig. 7. *Glaucomys sabrinus columbiensis*, ♀ ad., Penticton, B. C. (No. 1026, Victoria Mem. Mus.).

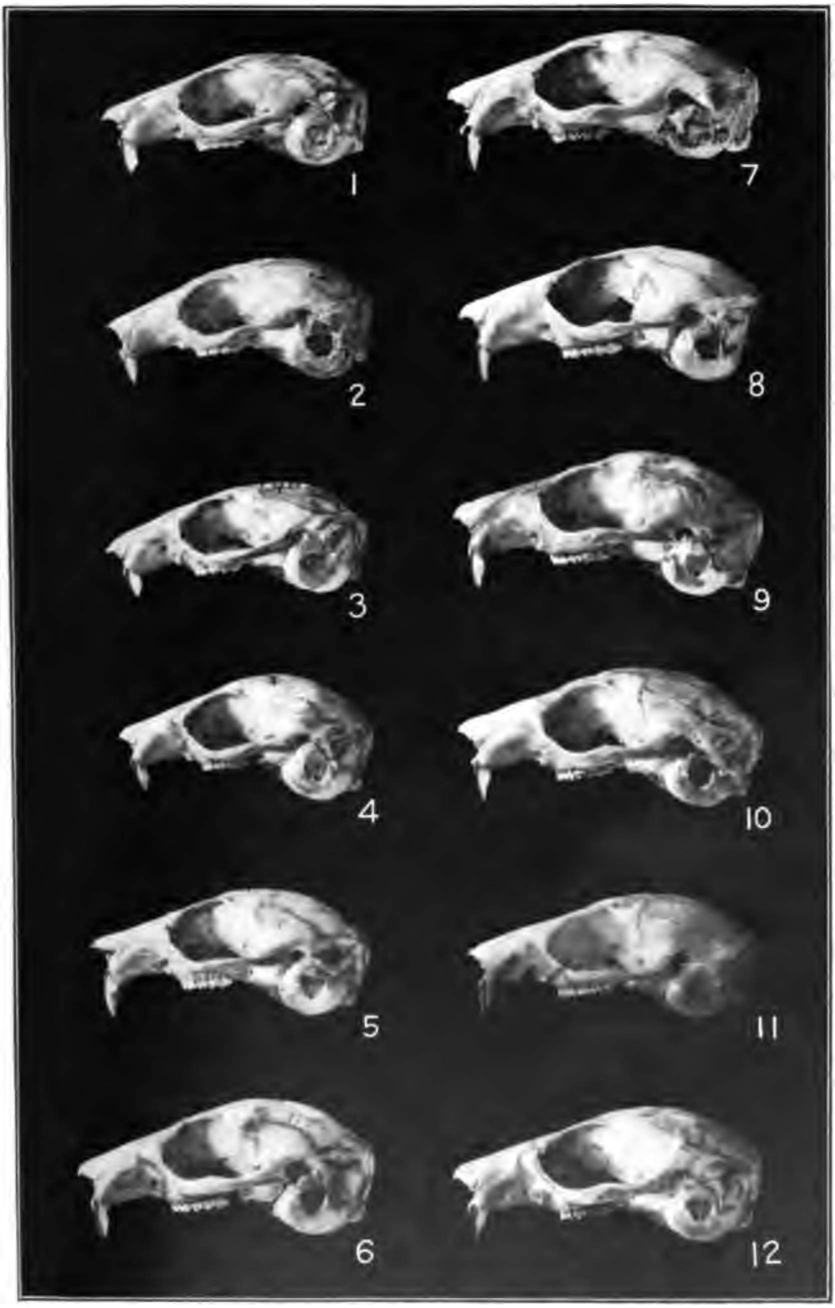
Fig. 8. *Glaucomys sabrinus oregonensis*, adult (type), Columbia River, Oreg. (No. 253, Acad. Nat. Sci. Philadelphia).

Fig. 9. *Glaucomys sabrinus zaphæus*, ♀ ad. (type), Helm Bay, Alaska (No. 136137, U. S. Nat. Mus., Biological Survey collection).

Fig. 10. *Glaucomys sabrinus bangsi*, ad., Florence, Mont. (No 168243, U. S. Nat. Mus., Biological Survey collection).

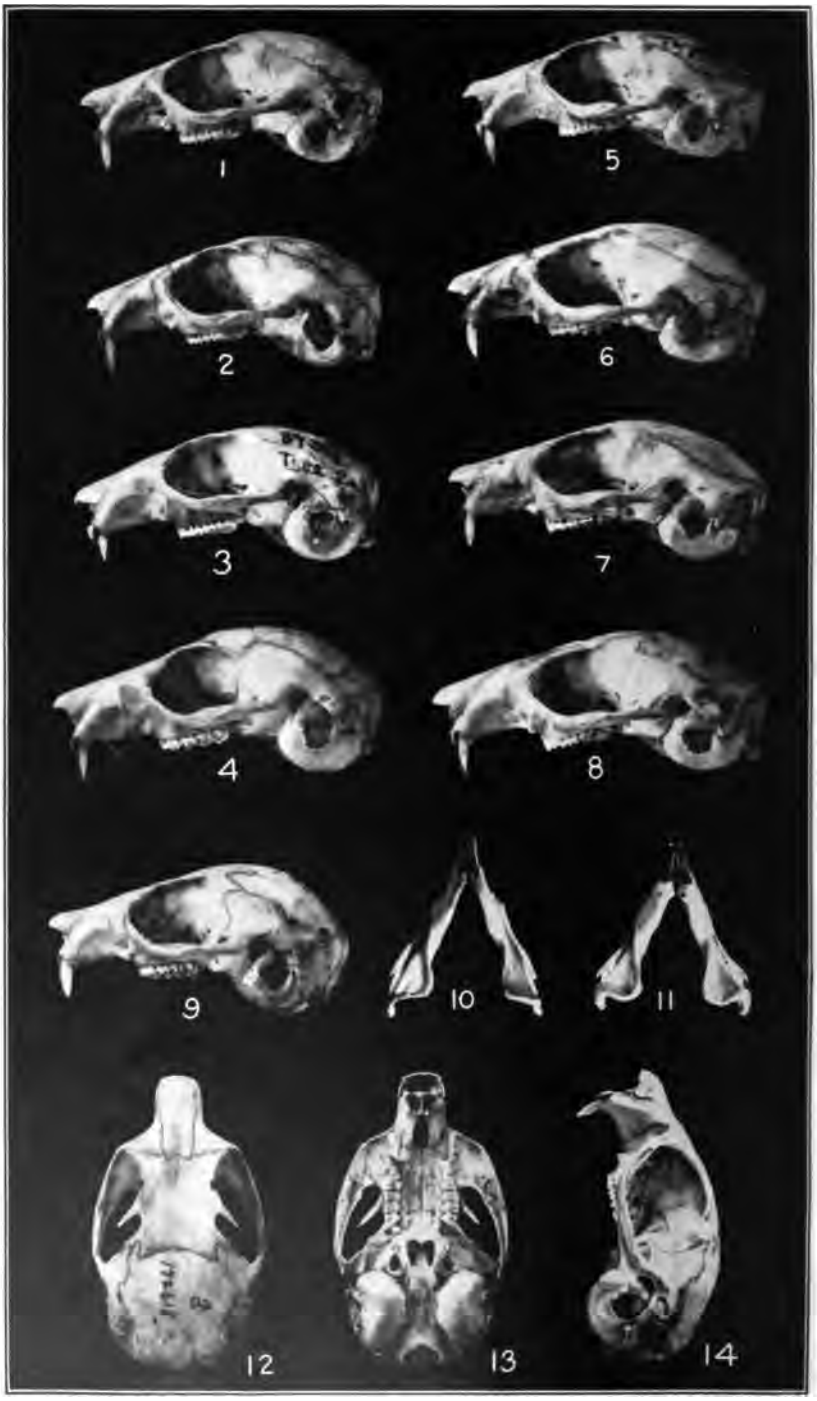
Fig. 11. *Glaucomys sabrinus canescens*, ♀ ad. (type), Portage la Prairie, Manitoba (No. 7663, Field Mus. Nat. Hist.).

Fig. 12. *Glaucomys sabrinus alpinus*, ♀ ad., Henry House, Alberta (No. 174398, U. S. Nat. Mus.).



SKULLS OF GLAUCOMYS VOLANS AND G. SABRINUS.

1. G. v. volans.
2. G. v. querceti.
3. G. v. saturatus.
4. G. v. texensis.
5. G. s. macrotis.
6. G. s. sabrinus.
7. G. s. columbiensis.
8. G. s. oregonensis.
9. G. s. zaphæus.
10. G. s. bangsi.
11. G. s. canescens.
12. G. s. alpinus.



SKULLS OF GLAUCOMYS SABRINUS AND PTEROMYS BÜCHNERI.

1. G. s. lascivus.
2. G. s. flaviventris.
3. G. s. klamathensis.
4. G. s. bullatus.
5. G. s. californicus.
6. G. s. olympicus.
7. G. s. fuliginosus.
8. G. s. latipes.
9. G. s. stephensi.
10. G. s. sabrinus.

11, 12, 13, 14. P. büchneri.

PLATE VII.

Fig. 1. *Glaucomys sabrinus lascivus*, ♀ ad., Cisco, Cal. (No. 19495, Mus. Vert. Zool.).

Fig. 2. *Glaucomys sabrinus flaviventris*, ♂ ad. (type), Bear Creek, Trinity County, Cal. (No. 13319, Mus. Vert. Zool.).

Fig. 3. *Glaucomys sabrinus klamathensis*, ♀ ad. (type), Fort Klamath, Oreg. (No. 87310, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys sabrinus bullatus*, ♂ ad., Ketchum, Idaho (No. 8499, Mus. Comp. Zool.).

Fig. 5. *Glaucomys sabrinus californicus*, ♀ ad. (type), San Bernardino Mountains, Cal. (No. 10487, Acad. Nat. Sci. Philadelphia).

Fig. 6. *Glaucomys sabrinus olympicus*, ♂ subad., Olympic Mountains, Wash. (No. 5905, Field Mus. Nat. Hist.).

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Fig. 8. *Glaucomys sabrinus latipes*, ♀ ad. (type), Glacier, B. C. (No. 68573, U. S. Nat. Mus., Biological Survey collection).

Fig. 9. *Glaucomys sabrinus stephensi*, ♂ ad., Laytonville, Cal. (No. 331, Cal. Acad. Sci.).

Fig. 10. *Glaucomys sabrinus sabrinus*, ♂ subad., Cochrane, Ontario (Carnegie Mus., not numbered).

Figs. 11, 12, 13, 14. *Pteromys büchneri*, ♂ ad., Shansi Mountains, China (No. 172618, U. S. Nat. Mus.).

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